3.3 Soil Resources

3.3.1 Regulatory Background

Soil resources are managed through a broad set of regulations, guidelines, and formal planning processes. These controls and directions are administered through federal, state, or local units of government. At the federal level, primary land management agencies include the USFS and the BLM. Through state and local agency offices, the Natural Resources Conservation Service (NRCS) administers soil conservation programs on private lands. In addition, the NRCS inventories Prime and Unique Farmlands, as identified in 7 CFR Part 657. These farmlands are of statewide or local importance to crop production. The Farmland Protection Policy Act states that federal programs that contribute to the unnecessary and irreversible conversion of farmland to non-agricultural uses will be minimized and shall be administered in a manner that, as practicable, are compatible with state and local government and private programs and policies to protect farmland.

On lands administered by the BLM, the agency addresses soil resources primarily through BLM Handbook H-4810-1, "Rangeland Health Standards," and by participating as a cooperating agency in the Colorado River Salinity Control Program. The Rangeland Health Standards are based on 43 CFR 4180.1, "Fundamentals of Rangeland Health." This regulation calls on the BLM to ensure that "watersheds are in, or are making significant progress toward, properly functioning physical condition, including their upland, riparian-wetland, and aquatic components; soil and plant conditions support infiltration, soil moisture storage, and the release of water that are in balance with climate and landform and maintain or improve water quality, water quantity, and timing and duration of flow." Individual BLM districts and field offices administer these regulations and guidelines, including soil conservation considerations, through RMPs and project-level assessments.

The USFS addresses soil resource management primarily by cooperating in the Colorado River Salinity Control Program and by implanting policy set forth in each Forest or Grassland Plan. Each national forest and grassland is governed by a management plan in accordance with the NFMA. These plans set management, protection and use goals and guidelines. The Forest Service Manual, Soil Management (Chapter 2550) and the Forest Service Handbook, Watershed Conservation Practices Handbook (Chapter 2509.25) specific to each region also provide policy and guidance on managing soil resources.

State conservation laws have been enacted in all of the states that would be traversed by the proposed TWE project. An example is Nevada's Conservation District Law (Nevada Revised Statutes Chapter 548). Through this type of state legislation, local soil conservation districts (SCDs) have been formed. These report to state administrative agencies, typically conservation commissions associated with state departments. The latter include the Colorado Department of Public Health and Environment, the Nevada Department of Conservation and Natural Resources, the Utah Division of Conservation and Resource Management (within the Department of Agriculture and Food), and the Wyoming Department of Agriculture. The SCDs are responsible for local planning, program development, and reporting in order to administer soil and water conservation programs. They interact with their respective state-level departments as well as the NRCS.

3.3.2 Data Sources

The soil baseline characterization for the proposed project is based on Soil Survey Geographic (SSURGO) database review and analyses. SSURGO is the most detailed level of soil mapping done by the NRCS (NRCS 2010). This investigation focused on soil characteristics or limitations of particular interest to the proposed transmission line construction. The results of the SSURGO data assessment are provided in Section 3.3.4.2, Soil Characteristics. Sensitive soils including prime farmland, hydric, highly erodible, limited revegetation potential, droughty, and landslide prone soils are described in further detail below.

In some cases, USFS soil surveys were available on some USFS lands. Where provided, soil analyses on the Forests were done using USFS specific data.

Locations where SSURGO and USFS soils data were not available, the soils were characterized using the U.S. General Soil Map (GSM). GSM consists of general soil association units. It was developed by the National Cooperative Soil Survey and supersedes the State Soil Geographic (STATSGO) dataset published in 1994. It consists of a broad-based inventory of soils and non-soil areas that occur in a repeatable pattern on the landscape and that can be cartographically shown at the scale mapped.

Information on Major Land Resource Areas (MLRAs) was obtained from the Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin, U.S. Department of Agriculture Handbook 296 (USDA 2006).

3.3.3 Analysis Area

The analysis area for soil resources encompasses the 2-mile-wide transmission line corridor that includes the proposed route and all alternative corridors.

3.3.4 Baseline Description

3.3.4.1 Major Land Resource Areas

Soil resources within the analysis area have formed within eight MLRAs. Generally, from north to south, these include the following (USDA 2006):

- MLRA 34A – Cool Central Desertic Basins and Plateaus;
- MLRA 34B – Warm Central Desertic Basins and Plateaus;
- MLRA 47 – Wasatch and Uinta Mountains;
- MLRA 48A – Southern Rocky Mountains;
- MLRA 29- Southern Nevada Basin and Range;
- MLRA 28A – Great Salt Lake Area;
- MLRA 35 – Colorado Plateau; and
- MLRA 30 – Mojave Desert.

A description of each MLRA follows, including the overall setting and soil types found within each.

<u>MLRA 34A – Cool Central Desertic Basins and Plateaus</u>

The Wyoming portion of this MLRA is bounded on most sides by mountains. The Owl Creek Mountains, the Big Horn Mountains, and the Wind River Range are to the north; the Salt Range and Wasatch Mountains are to the west; and the Laramie and Sierra Madre Mountains are to the east. The part of the MLRA in Colorado is bounded on the south by the Roan Plateau, on the east by the Elkhead Mountains, and on the west by Dinosaur National Monument. In most of the MLRA, elevation ranges from 5,200 feet to 7,500 feet amsl. Small mountainous areas have an elevation as high as 9,200 feet amsl.

The soils in MLRA 34A are generally calcareous and range from shallow or moderately deep to sedimentary bedrock. Alluvial and eolian deposits also are present within the MLRA. Some of the soils formed in slope alluvium or residuum derived from shale or sandstone. Soils that formed in stream- or river-deposited alluvium are near the major waterways. The average annual precipitation is 7 to 12 inches and the freeze-free period ranges from 45 to 160 days. The dominant soil orders in this MLRA are Aridisols and Entisols. Aridisols are well developed soils that have a very low concentration of organic matter and form in an arid or semi-arid climate. In contrast, Entisols are considered recent soils that lack soil development because erosion or deposition rates occur faster than the rate of soil development.

MLRA 34B – Warm Central Desertic Basins and Plateaus

This MLRA consists of broad intermountain basins bounded by plateaus and steep escarpments. The northern part of the MLRA occurs in the Uinta Basin Section, which is bounded by the Uinta Mountains to the north, the Wasatch Range to the west, the Roan Plateau to the south, and the Rabbit Hills to the east. The southern part of the MLRA occurs in the northern third of the Canyon Lands Section. This section is bounded by the Roan Plateau to the north, the Wasatch Plateau to the west, the southern end of the San Rafael Swell to the south, and the western slope of the Rocky Mountains to the east. Elevation ranges from 4,100 feet near Green River, Utah, to 7,500 feet amsl at the base of the Wasatch Range and the Roan Plateau.

The soils in MLRA 34B generally are calcareous and shallow or moderately deep to sedimentary bedrock. The soils that formed in material weathered from Mancos Shale tend to be saline and high in selenium. Cretaceous shales often weather to form expansive clays that are prone to shrink swell (expansion) and slumping. Most of the soils formed in slope alluvium or residuum derived from shale or sandstone. Soils that formed in alluvium occur near the major waterways, and soils that formed in colluvium occur generally on slopes of more than 35 percent. The soils at the lower elevations generally have significant amounts of calcium carbonate, salts, and gypsum. The dominant soil orders in this MLRA are Aridisols and Entisols. Mollisols occur at the higher elevations, particularly in the northern part of the MLRA. Mollisols are fertile soils with high organic matter and a nutrient-enriched, thick dark surface. Aridisols and Entisols are described in the preceding text.

MLRA 47 – Wasatch and Uinta Mountains

The MLRA includes the Wasatch Mountains, which trend north and south, and the Uinta Mountains, which trend east and west. The steep sloping, precipitous Wasatch Mountains have narrow crests and deep valleys. Active faulting and erosion are a dominant force in controlling the geomorphology of the area. The Uinta Mountains have a broad, gently arching, elongate shape. Structurally, they consist of a broadly folded anticline that has an erosion resistant quartzite core. Some of the mountain areas that are above 7,500 feet and all of the areas above 10,000 feet have been subject to alpine or mountain glaciation. There are arêtes, horns, cirques, all types of moraines, and outwash features. In the southern part of the MLRA, there are rolling mountains and thrust-faulted plateaus that are broad, gently sloping surfaces with steep side slopes that have deep canyons cut into them. The Wasatch and Uinta Mountains have an elevation of 4,900 to about 13,500 feet amsl.

The soils in MLRA 47 primarily formed in slope alluvium, alluvium, colluvium, or residuum derived from sedimentary and igneous rocks. Alluvial fans at the base of the mountains are recharge zones for the basin fill aquifer. Soils derived from the Green River shale unit are fissile, calcareous, soft, and readily break down into clay- and silt-sized particles. The clay layers in sub-horizons impede root growth in locations. These soils also are often truncated due to sheet erosion. Soils derived from the North Horn Formation are subject to soil creep, slumping, and large landslide events. As the soils become saturated the probability of soil movement increases. For additional information on landslide prone areas refer to Section 3.2.5.1, Geology Regional Summary. The dominant soil orders in this MLRA are Aridisols, Entisols, Inceptisols, and Mollisols. Inceptisols are soils that exhibit minimal horizon development, but exhibit more soil development that Entisols. They are often shallow to bedrock or on steeply sloping lands. Aridisols, Entisols, and Mollisols are described in the preceding text.

MLRA 48A – Southern Rocky Mountains

The Southern Rocky Mountains consist primarily of two belts of strongly sloping to precipitous mountain ranges trending north to south. The ranges are dissected by many narrow stream valleys having steep gradients. In some areas the upper mountain slopes and broad crests are covered by snowfields and glaciers. Several basins, or parks, are between the belts. Some high mesas and plateaus are included. High plateaus and steep-walled canyons are fairly common, especially in the west. Elevation typically ranges from 6,500 to 14,400 feet in this area.

The soils in MLRA 48A primarily formed in slope alluvium and colluvium on mountain slopes or residuum on mountain peaks derived from igneous, metamorphic, and sedimentary parent materials. Younger igneous parent materials, primarily basalt and andesitic lava flows, tuffs, breccias, and conglomerates, are located throughout this area. Representative formations in this area are the Silver Plume and Pikes Peak granites, San Juan Volcanics, and Mancos Shale. Alluvial fans at the base of the mountains are recharge zones for local basin and valley fill aquifers. The dominant soil orders in this MLRA are Mollisols, Alfisols, Inceptisols, and Entisols, which are described in the preceding text.

MLRA 29 – Southern Nevada Basin and Range

This MLRA is an area of broad, nearly level, aggraded desert basins and valleys between a series of mountain ranges trending north to south. The basins are bordered by sloping fans and terraces. The mountains are uplifted fault blocks with steep side slopes. The mountains are not well dissected due to a low amount of rainfall. Most of the valleys in this MLRA are closed basins containing sinks or playa lakes. Elevation ranges from 1,950 to 5,600 feet in the valleys and up to 9,400 feet in the mountains.

The soils in MLRA 29 primarily formed in alluvium on alluvial fans and fan pediments or residuum and colluvium on mountain slopes. Parent materials are derived from andesite, carbonate, and basalt. The soils generally are very shallow to very deep, well drained or somewhat excessively drained, and loamy-skeletal or sandy-skeletal. The valleys consist mostly of alluvial fill, but playa deposits occur at the lowest elevations in the closed basins. The alluvial valley fill consists of cobbles, gravel, and coarse sand near the mountains in the apex of the alluvial fans. Sands, silts, and clays are on the distal ends of the fans. The dominant soil orders in this MLRA are Aridisols and Entisols, which are described in the preceding text.

MLRA 28A – Great Salt Lake Area

This MLRA is an area of nearly level basins between widely separated mountain ranges trending north to south. The basins are bordered by long, gently sloping alluvial fans. The mountains are uplifted fault blocks with steep side slopes. They are not well dissected because of low rainfall. A large salt desert playa is south and west of Great Salt Lake. Most of the valleys in this MLRA are closed basins containing sinks or playa lakes. Elevation ranges from 3,950 to 6,560 feet amsl in the basins and from 6,560 to 11,150 feet amsl in the mountains.

The soils in MLRA 28A primarily formed in alluvium on alluvial fans, terraces, lake plains, and fan pediments or residuum and colluvium on mountain slopes. Dune lands formed in eolian materials. The soils in this area generally are well drained or somewhat excessively drained, loamy or loamy skeletal (lacking soil horizons and rocky), and very deep. Most of this area has alluvial valley fill and playa lakebed deposits at the surface. The dominant soil orders in this MLRA are Aridisols, Entisols, and Mollisols, which are described in the preceding text.

MLRA 35 – Colorado Plateau

In general, the surface consists of gently sloping to strongly sloping plains. Volcanic plugs that rise abruptly above the plains, steep scarps, or deeply incised canyons interrupt the surface of the plains. In most areas elevation is 4,250 to 4,950 feet amsl but the mountains range from 8,000 to 10,385 feet amsl.

The soils in MLRA 35 primarily formed in eolian deposits or alluvium on alluvial fans, cuestas, mesas, fan terraces, and fan pediments or residuum and colluvium on mesas, hills, ridges, and mountain slopes. Areas of shale, sandstone, limestone, dolomite, and volcanic rock outcrop are extensive. The dominant soil orders in this MLRA are Alfisols, Aridisols, Entisols, and Mollisols. Alfisols have a clay-enriched subsoil and relatively high native fertility. Alfisols typically form under forests. Aridisols, Entisols, and Mollisols are described in the preceding text.

MLRA 30 – Mojave Desert

Broad basins, valleys, and old lakebeds make up most of the area, but widely spaced mountains trending north to south occur throughout the area. Isolated, short mountain ranges are separated by an aggraded desert plain. Long alluvial fans coalesce with dry lakebeds between some of the ranges. Elevation ranges from 282 feet below sea level in Death Valley to 3,950 feet amsl in valleys and basins. Some mountain ranges have peaks that exceed 11,100 feet amsl.

The soils in MLRA 30 primarily formed in alluvial deposits on alluvial fans and valley floors. The soils are generally well drained to excessively drained, loamy-skeletal or sandy-skeletal, and shallow to very deep. They developed from metamorphic, igneous, carbonates, granitics, and nonmarine sedimentary and volcanic deposits. Recent alluvial fans and remnant alluvial fan terraces typically grade from boulder-strewn deposits and coarse desert pavement near the fan apex to finer grained sands, silts, and clays at the distal ends. Playas are at the lowest elevations in the closed basins. They commonly have eolian accumulations along their downwind fringes. Water from shallow subsurface flow and from surface flows that periodically fill the playa basins evaporates, leaving accumulations of evaporite minerals, including salts and borates. Saline and sodic soils are common.

The dominant soil orders in this MLRA are Aridisols and Entisols, which have been described in the preceding text.

3.3.4.2 Soil Characteristics

Soil characteristics such as susceptibility to erosion and the potential for revegetation are important to consider when planning for construction activities and stabilization of disturbed areas. These hazards or limitations for use are a function of many physical and chemical characteristics of each soil, in combination with the climate and vegetation. Sensitive soils including prime farmland, hydric, highly erodible, limited revegetation potential, droughty, and other important soil characteristics are described in further detail below.

Water erosion is the detachment and movement of soil by water. Natural erosion rates depend on inherent soil properties, slope, soil cover, and climate. Erosion prone soils were characterized as having a soil erodibility factor (Kw) greater than 0.28 and slope greater than15 percent. Wind erosion is the physical wearing of the earth's surface by wind. Wind erosion removes and redistributes soil. Small blowout areas may be associated with adjacent areas of deposition at the base of plants or behind obstacles, such as rocks, shrubs, fence rows, and roadbanks (Soil Quality Institute 2001). Wind erodible soils were characterized as having a wind erodibility group value of 1 or 2.

Soils with LRP have chemical characteristics such as high salts, sodium, or pH that may limit plant growth. Saline soils affect plant uptake of water and sodic soils often have drainage limitations. In addition, the success of stabilization and restoration efforts in these areas may be limited unless additional treatments and practices are employed to offset the adverse physical and chemical characteristics of the soils.

Prime farmland is land that has the best combination of physical and chemical characteristics for producing crops and that is available for these uses. It has the combination of soil properties, growing season, and moisture supply needed to produce sustained high yields of crops in an economic manner if it is treated and managed according to acceptable farming methods. These soils have the capability to be prime farmland, but may have not yet been developed for irrigated agriculture uses.

Hydric soils are soils that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part. These soils are commonly associated with floodplains, lake plains, basin plains, and with riparian areas, wetlands, springs, and seeps. Due to the scale of mapping, small areas of hydric soils may not be captured by this dataset.

In areas with a shallow depth to lithic bedrock (relative to the structure foundation excavation depth), excavation may result in rock fragments remaining on the surface at levels that would limit the success of restoration efforts. Where the alternative routes cross soils with lithic bedrock, blasting or specialized drilling equipment may be required for installing structure foundations.

Soil compaction occurs when soil particles are pressed together and the pore spaces between them are reduced and bulk density is increased. This results in a decrease in infiltration and an increase in runoff and erosion. Moist, fine textured (clayey) soils are most susceptible to compaction. Soils with greater than 28 percent clay were interpreted as compaction prone.

Soil limitations within the analysis area related to shallow excavations include cutback caving, flooding, large stones, slope, and a cemented pan within the soil profile. These limitations are important to consider during construction.

Other sensitive soils within the analysis area include expansive soils, collapsible soils, and soils with a high susceptibility to subsidence, dissolution, or piping.

Corrosion potential pertains to soil-induced electrochemical or chemical action that corrodes or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors results in a severe hazard of corrosion. For uncoated steel, the risk of corrosion is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract. For concrete, the risk of corrosion is based on soil texture, acidity, and amount of sulfates in the saturation extract (NRCS 2011).

Biological soil crusts are considered an important component in dry arid ecosystems. They provide soil stability, prevent erosion, fix nitrogen, increase infiltration rates, and may reduce noxious weed migration. Biological soil crusts occur throughout the analysis area. The southern portion of the analysis area (specifically the northeast portion of the Mojave Desert) has a relatively high cover of biological soil crusts. No data exist on soil crust coverage of the entire analysis area; however, research shows that biological soil crusts do best where sedimentary parent materials are found (Belnap et al. 2003). In arid environments, biological soil crusts are essential for soil stability due to minimal vegetative growth and soil cover.

3.3.5 Regional Summary

Table 3.3-1 summarizes MLRAs along with important soil limitations within each region. Soils with severe wind and water erosion potential and soils with limited revegetation potential and farmlands of statewide importance along with the MLRAs within each region are depicted in **Figures 3.3-1** through **3.3-16**.

3.3.6 Impacts to Soils

The impact analysis area for soil resources encompasses the applicant-proposed route and all alternatives, and includes a 250-foot-wide transmission line ROW centered on each reference line to analyze all impacts except for the access roads and other ancillary facilities and work areas. For the analysis of the access roads, ancillary facilities, and work areas, a generally 2-mile transmission line corridor along the proposed and alternative routes would be used. A larger analysis area for access roads was required because their locations have not been defined at this time.

Table 3.3-1 Soil Limitations Within the Regions and MLRAs (Percentage)

Region	MLRA Number	Wind Erosion	Water Erosion	Compaction	Limited Revegetation Potential	Hydric	Prime Farmland	Shallow Bedrock	Risk of Corrosion – Concrete	Risk of Corrosion – Steel	Shallow Excavations	Small Commercial Buildings
I	34A	5.4	5.7	13.9	19.0	0.1	3.0	6.4	5.3	28.8	12.0	15.9
	34B	<0.1	1.4	2.7	2.0	0	0.9	0.3	2.3	3.2	2.2	3.1
	48A	<0.1	<0.1	0.1	<0.1	0	0	0	<0.1	0.1	0	0
II	47	<0.1	1.3	6.3	3.1	<0.1	0.4	5.0	0.2	9.0	4.9	5.4
	28A	3.0	0.1	3.2	6.1	0.8	2.0	1.9	4.9	11	7.5	7.7
	34B	1.1	4.6	14.7	16.5	0.1	2.8	6.9	9.2	27.0	17.9	21.8
	48A	0	0.1	1.4	1.6	0	0.9	2.1	0.2	3.3	1.7	1.9
III	29	<0.1	0.3	4.6	1.8	0	1.5	4.1	0.2	6.7	7.4	6.9
	30	1.2	0.9	1.8	3.9	0.1	0	12.2	2.1	19.2	17.5	16.9
	47	0	0	1.1	0.3	0	<0.1	1.3	<0.1	0.6	0.1	0.1
	28A	1.7	0	16.8	32.4	0.8	2.7	4.0	13.8	41.7	15.8	14.4
IV	30	8.6	0.8	0	26.2	0	0	21.1	17.9	65.1	75.1	73.3

Note: GSM data did not have interpretations for shallow excavations, small commercial buildings, or prime farmland. Percentages for these interpretations exclude areas with only GSM data.

Source: USDA 2006; NRCS 2011.

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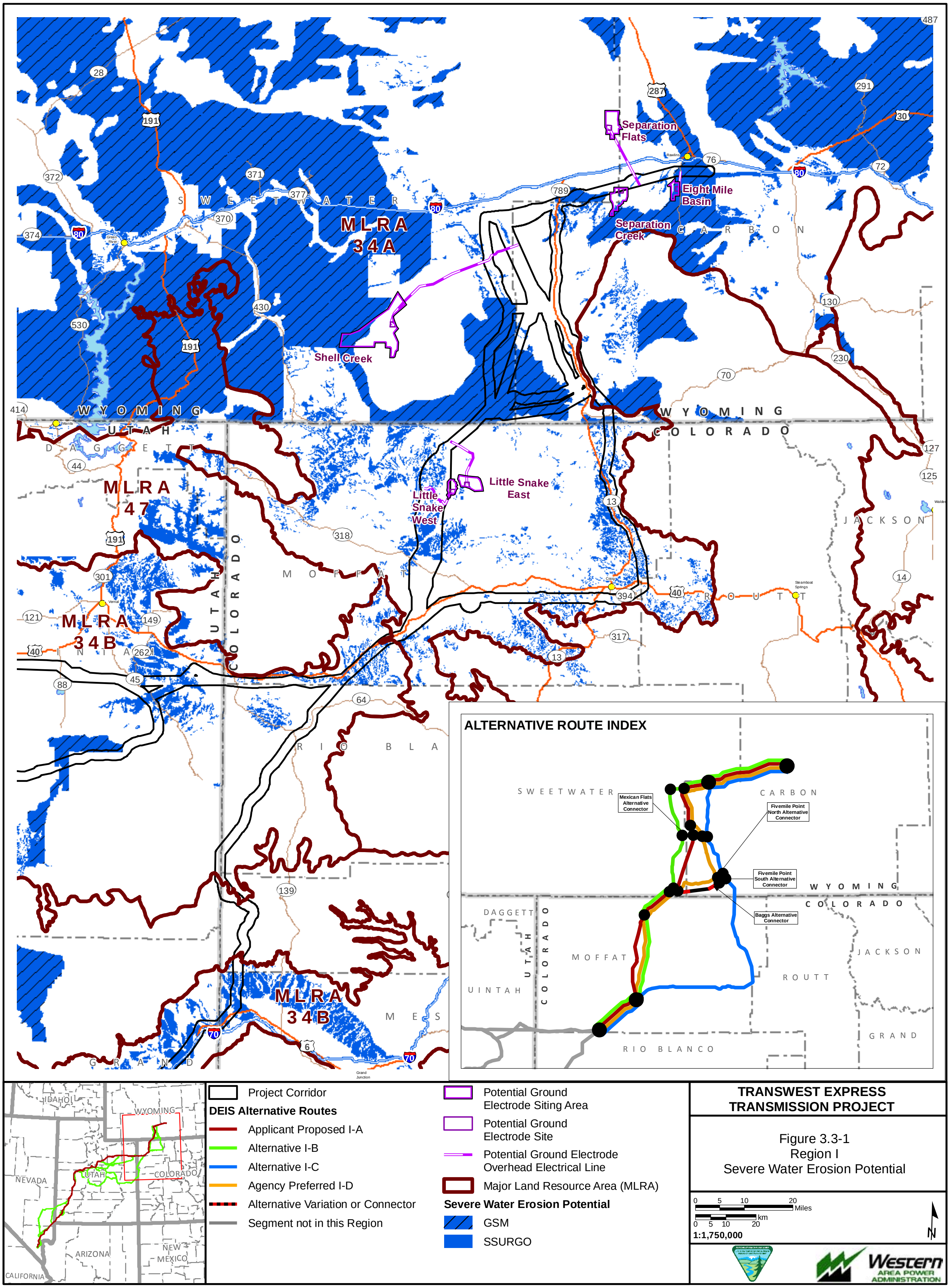

Figure 3.3-1
Region I
Severe Water Erosion Potential

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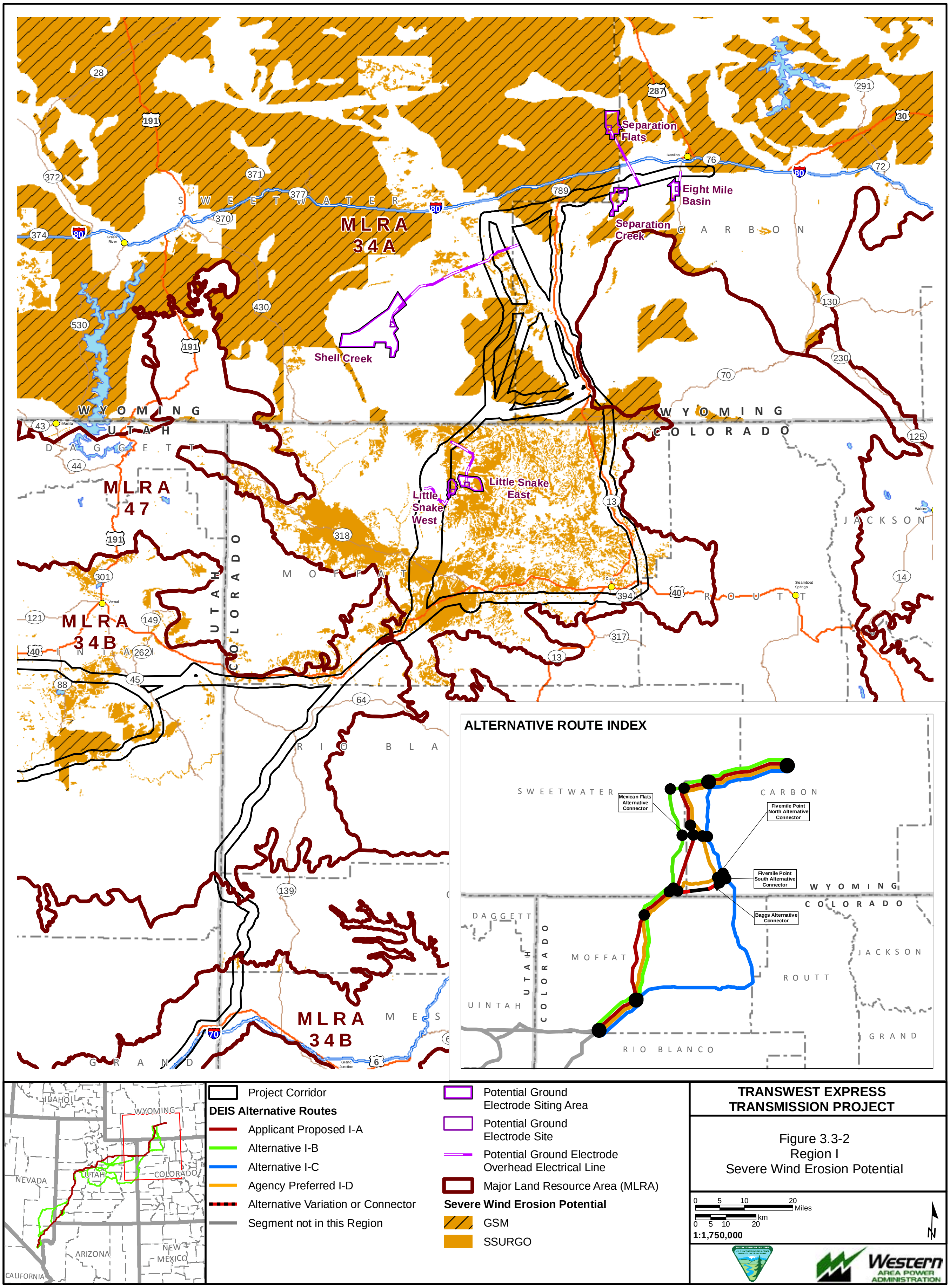

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Figure 3.3-2
Region I
Severe Wind Erosion Potential

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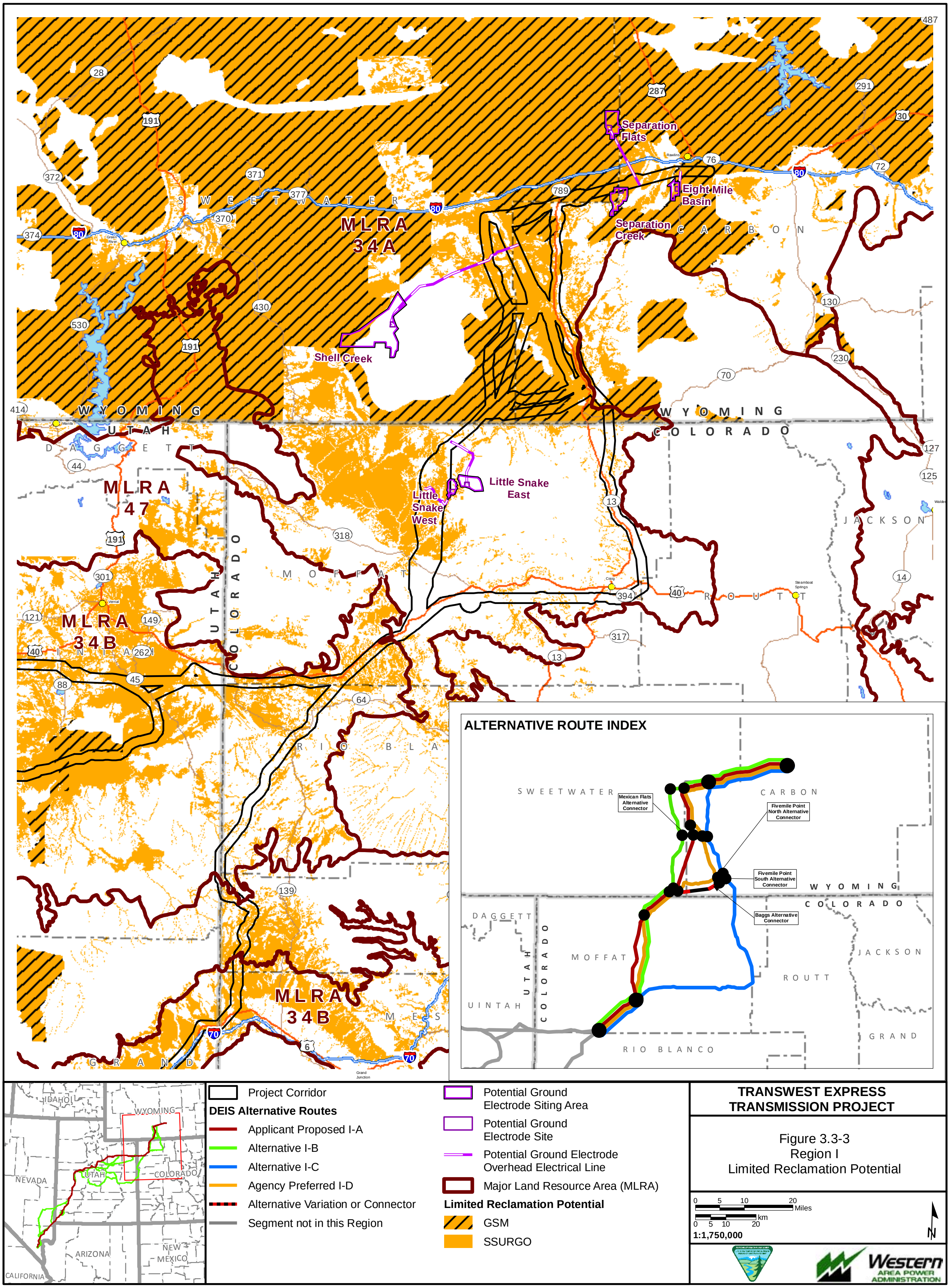

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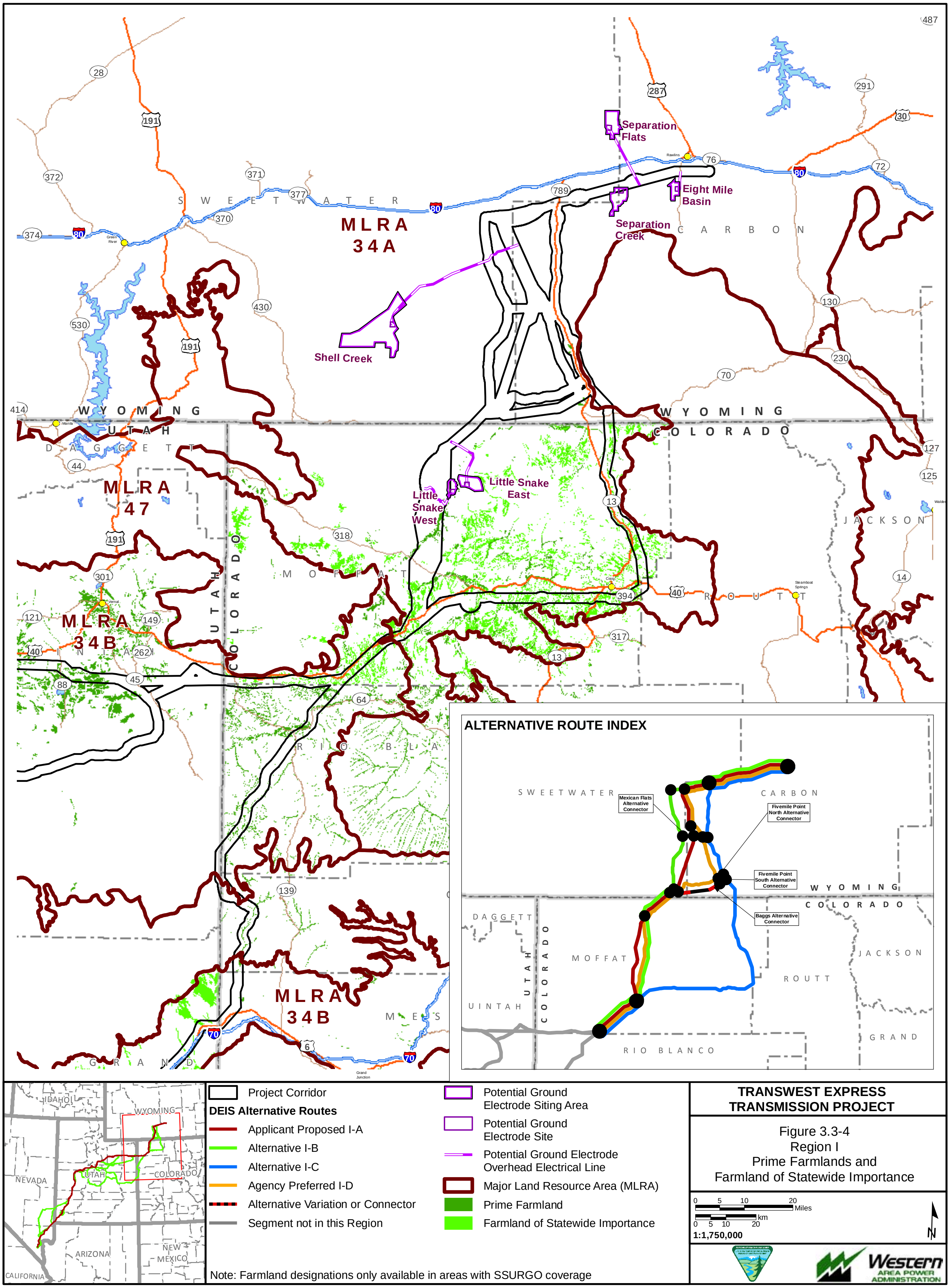

- Project Corridor

DEIS Alternative Routes

- Applicant Proposed I-A
- Alternative I-B
- Alternative I-C
- Agency Preferred I-D
- Alternative Variation or Connector
- Segment not in this Region
- Potential Ground Electrode Siting Area
- Potential Ground Electrode Site
- Potential Ground Electrode Overhead Electrical Line
- Major Land Resource Area (MLRA)
- Prime Farmland
- Farmland of Statewide Importance

Note: Farmland designations only available in areas with SSURGO coverage

TRANSWEST EXPRESS TRANSMISSION PROJECT

Figure 3.3-4
Region I
Prime Farmlands and Farmland of Statewide Importance

0 5 10 20 Miles
0 5 10 20 km
1:1,750,000

N

Western Area Power Administration

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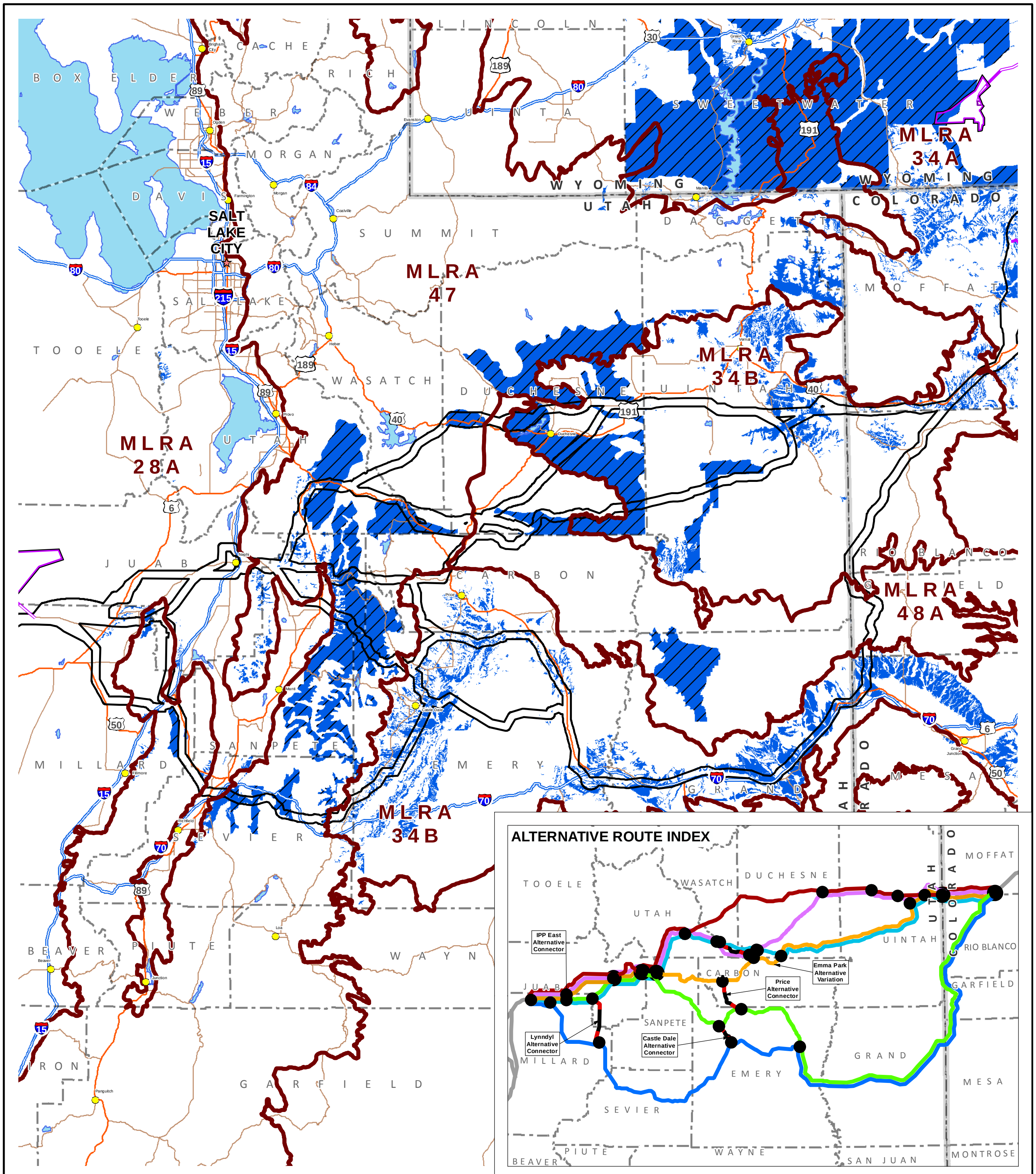

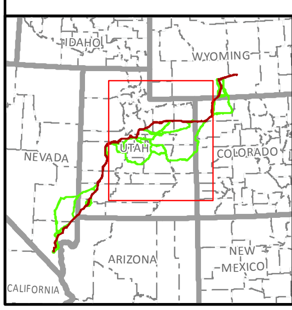

Project Corridor

DEIS Alternative Routes

- Applicant Proposed II-A
- Alternative II-B
- Alternative II-C
- Alternative II-D
- Alternative II-E
- Agency Preferred II-F
- Alternative Variation or Connector
- Segment not in this Region

Potential Ground Electrode Siting Area

Potential Ground Electrode Site

Potential Ground Electrode Overhead Electrical Line

Major Land Resource Area (MLRA)

Severe Water Erosion Potential

- GSM
- SSURGO

TRANSWEST EXPRESS TRANSMISSION PROJECT

Figure 3.3-5
Region II
Severe Water Erosion Potential

0 10 20 40 Miles
0 10 20 40 km
1:2,250,000

N

Western Area Power Administration

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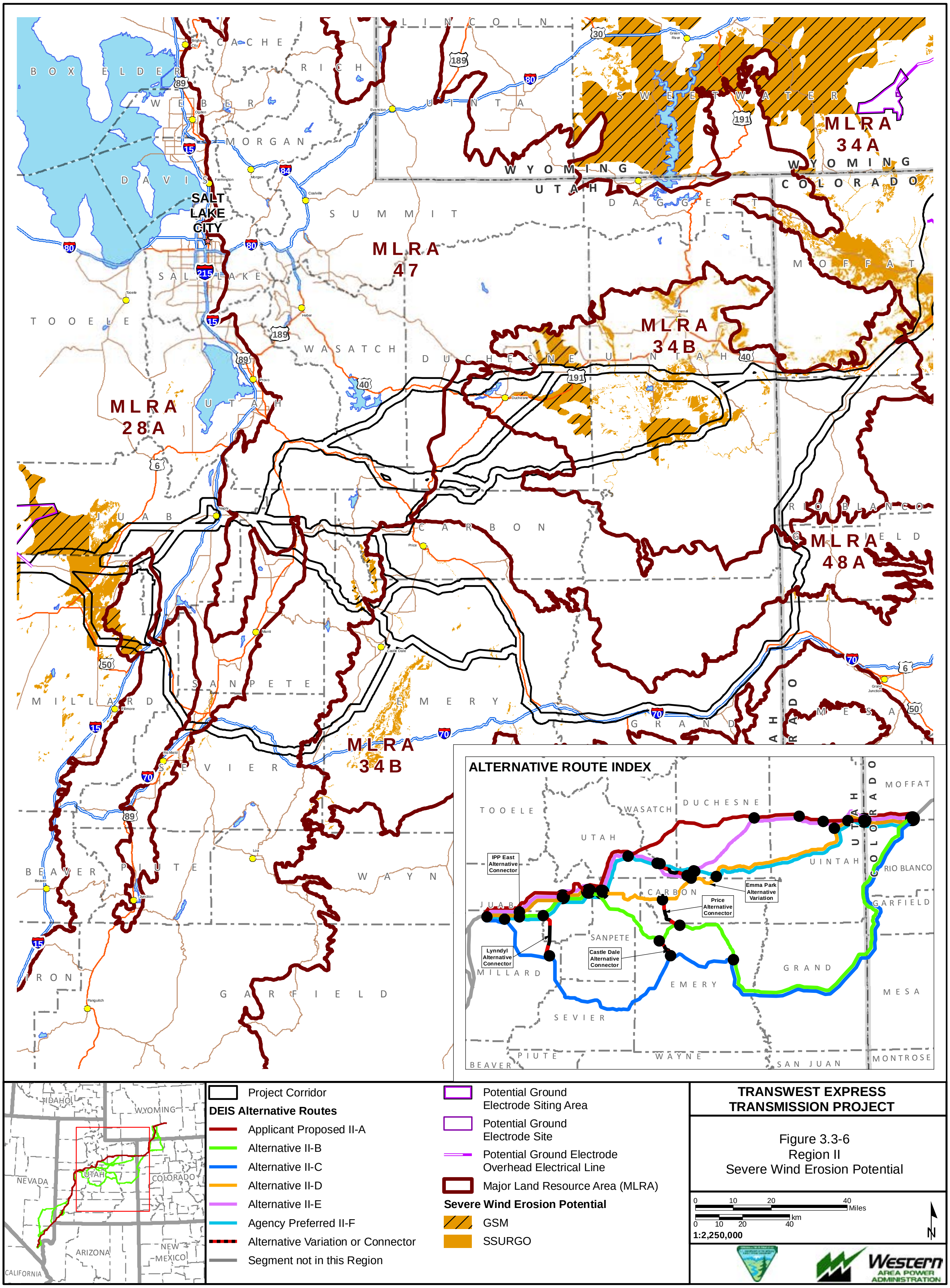

TRANSWEST EXPRESS TRANSMISSION PROJECT

Figure 3.3-6
Region II
Severe Wind Erosion Potential

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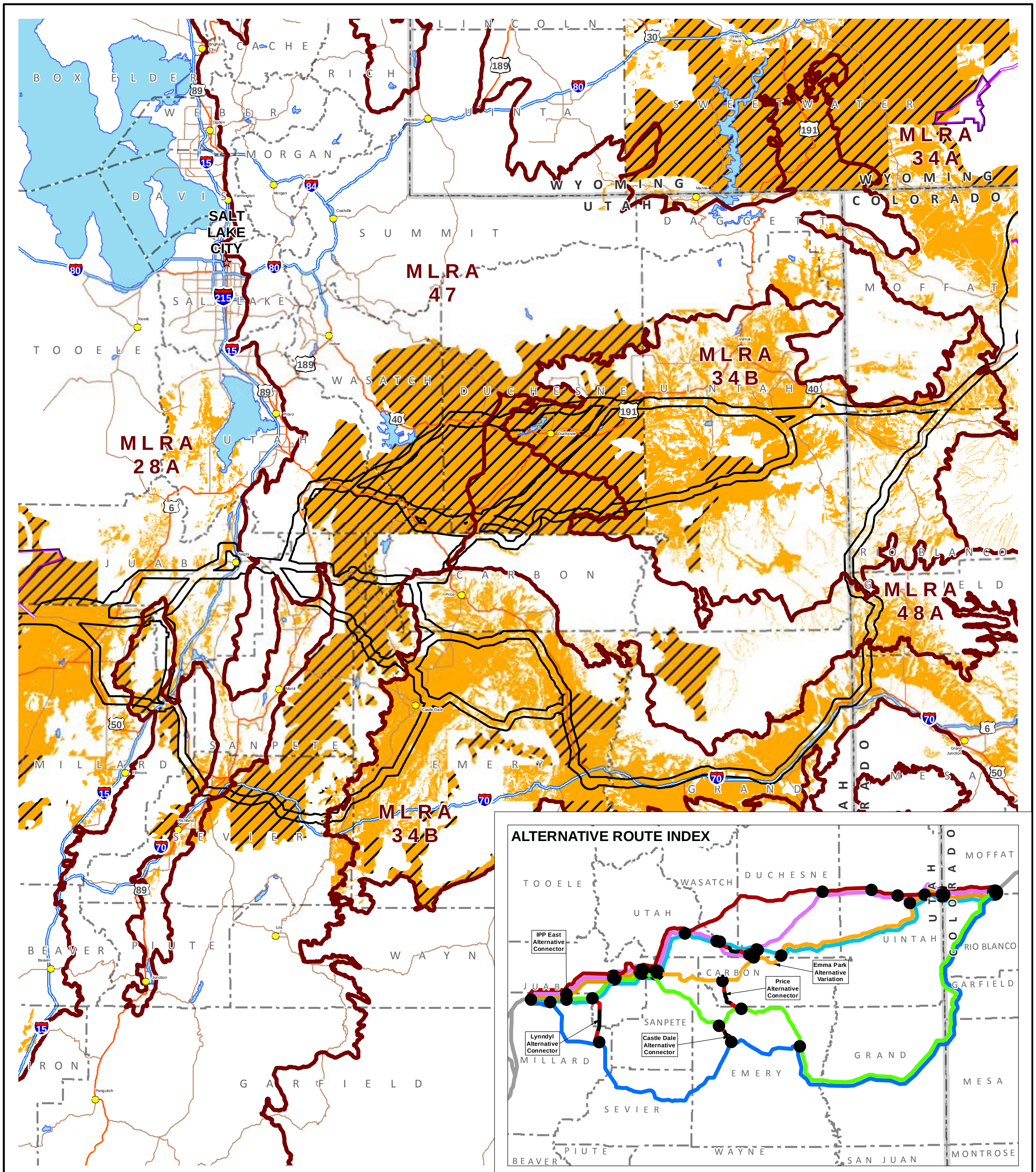

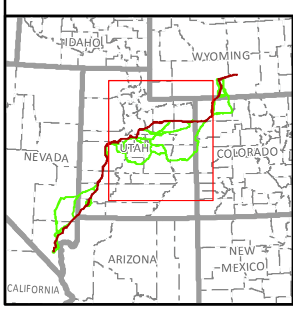

Project Corridor	
DEIS Alternative Routes	
Applicant Proposed II-A	
Alternative II-B	
Alternative II-C	
Alternative II-D	
Alternative II-E	
Agency Preferred II-F	
Alternative Variation or Connector	
Segment not in this Region	
Potential Ground Electrode Siting Area	
Potential Ground Electrode Site	
Potential Ground Electrode Overhead Electrical Line	
Major Land Resource Area (MLRA)	
Limited Reclamation Potential	
GSM	
SSURGO	

TRANSWEST EXPRESS TRANSMISSION PROJECT

Figure 3.3-7
Region II
Limited Reclamation Potential

0 10 20 40 Miles
0 10 20 40 km
1:2,250,000
N

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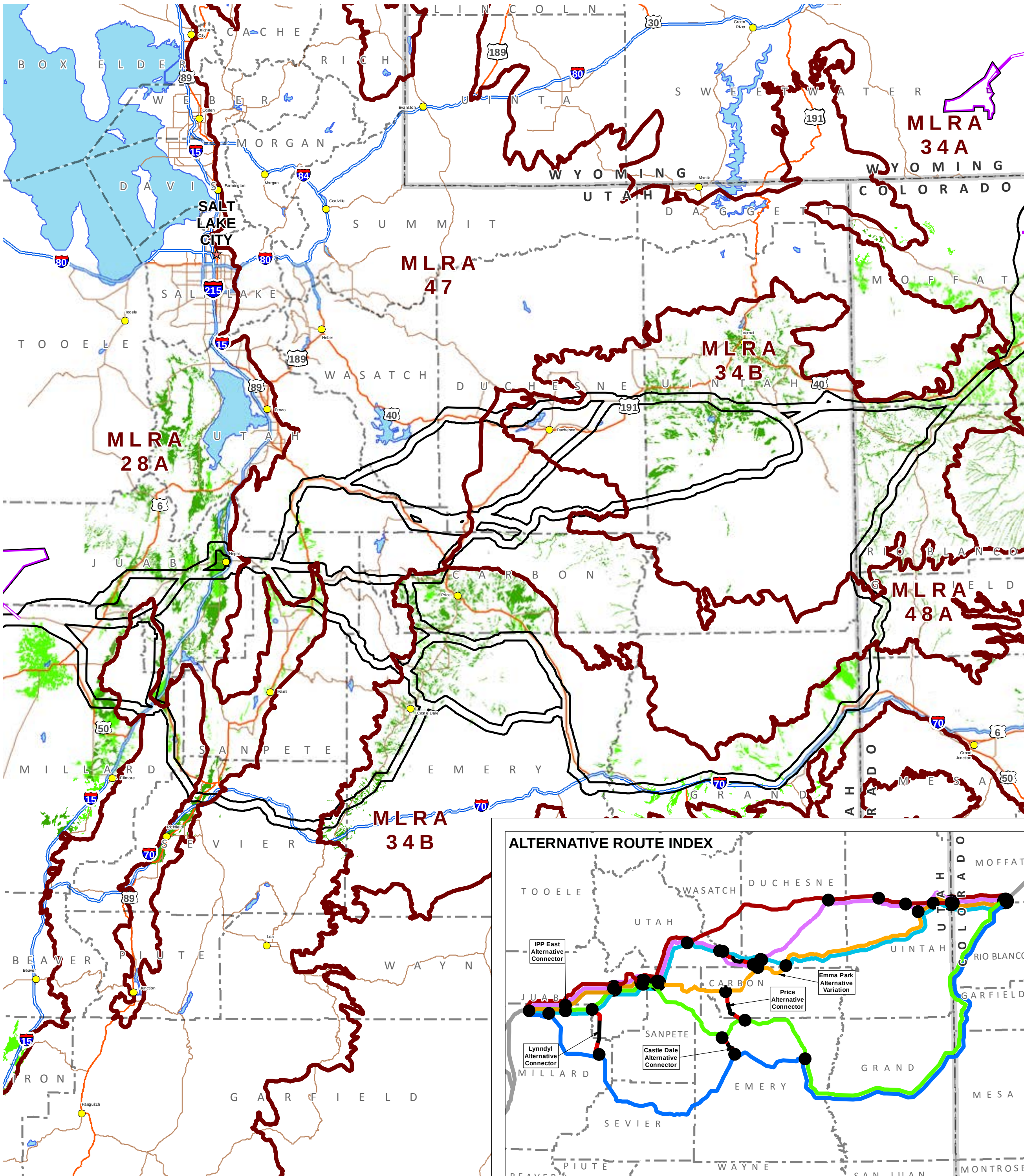

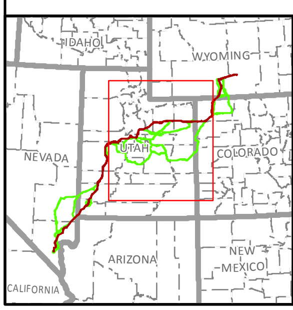

- Project Corridor

DEIS Alternative Routes

- Applicant Proposed II-A
- Alternative II-B
- Alternative II-C
- Alternative II-D
- Alternative II-E
- Agency Preferred II-F
- Alternative Variation or Connector
- Segment not in this Region

- Potential Ground Electrode Siting Area
- Potential Ground Electrode Site
- Potential Ground Electrode Overhead Electrical Line
- Major Land Resource Area (MLRA)
- Prime Farmland
- Farmland of Statewide Importance

Note: Farmland designations only available in areas with SSURGO coverage

TRANSWEST EXPRESS TRANSMISSION PROJECT

Figure 3.3-8
Region II
Prime Farmlands and
Farmland of Statewide Importance

0 10 20 40 Miles
0 10 20 40 km
1:2,250,000

N

Western Area Power Administration

Exported On: 3/7/2013

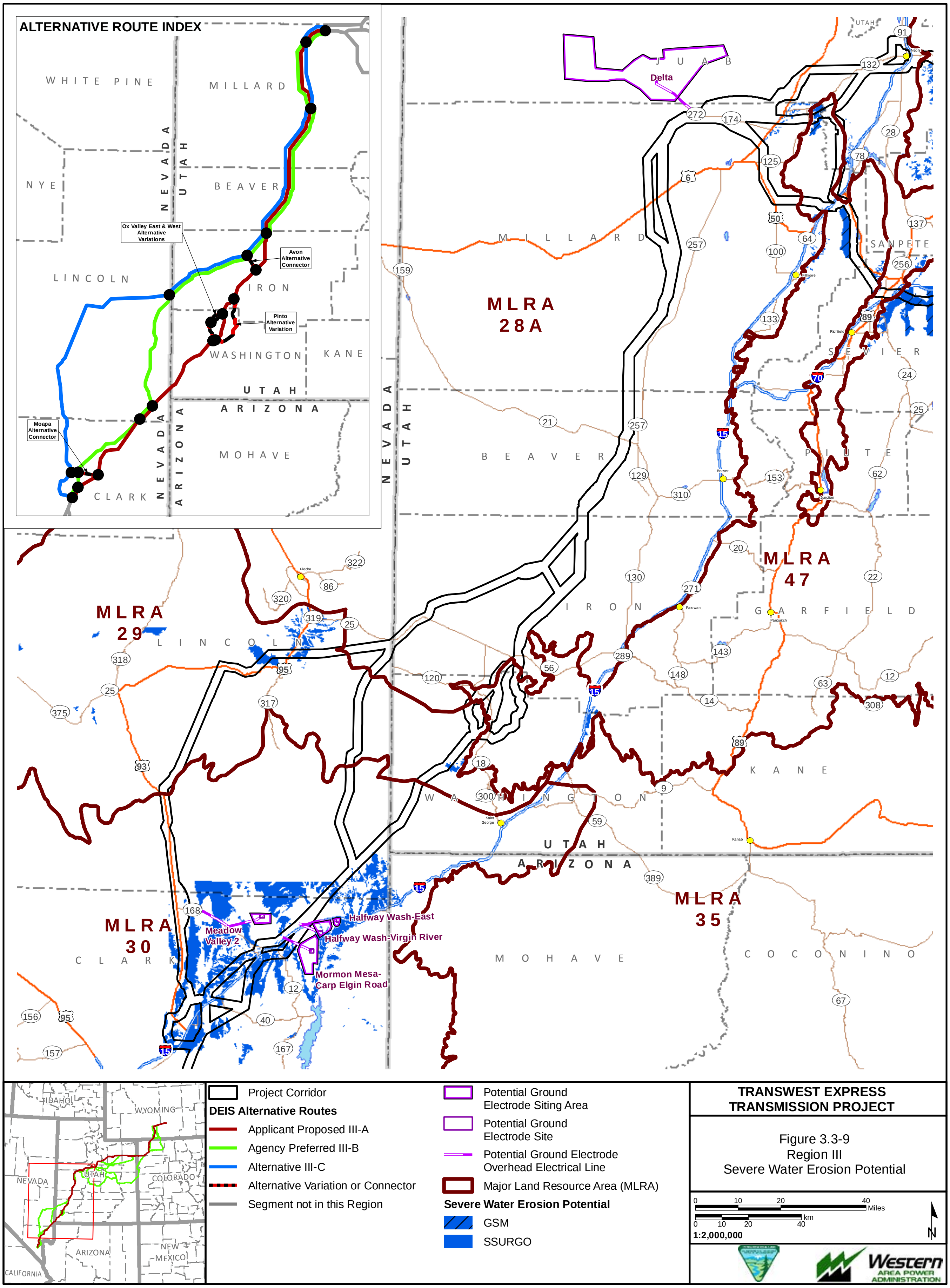

Figure 3.3-9
Region III
Severe Water Erosion Potential

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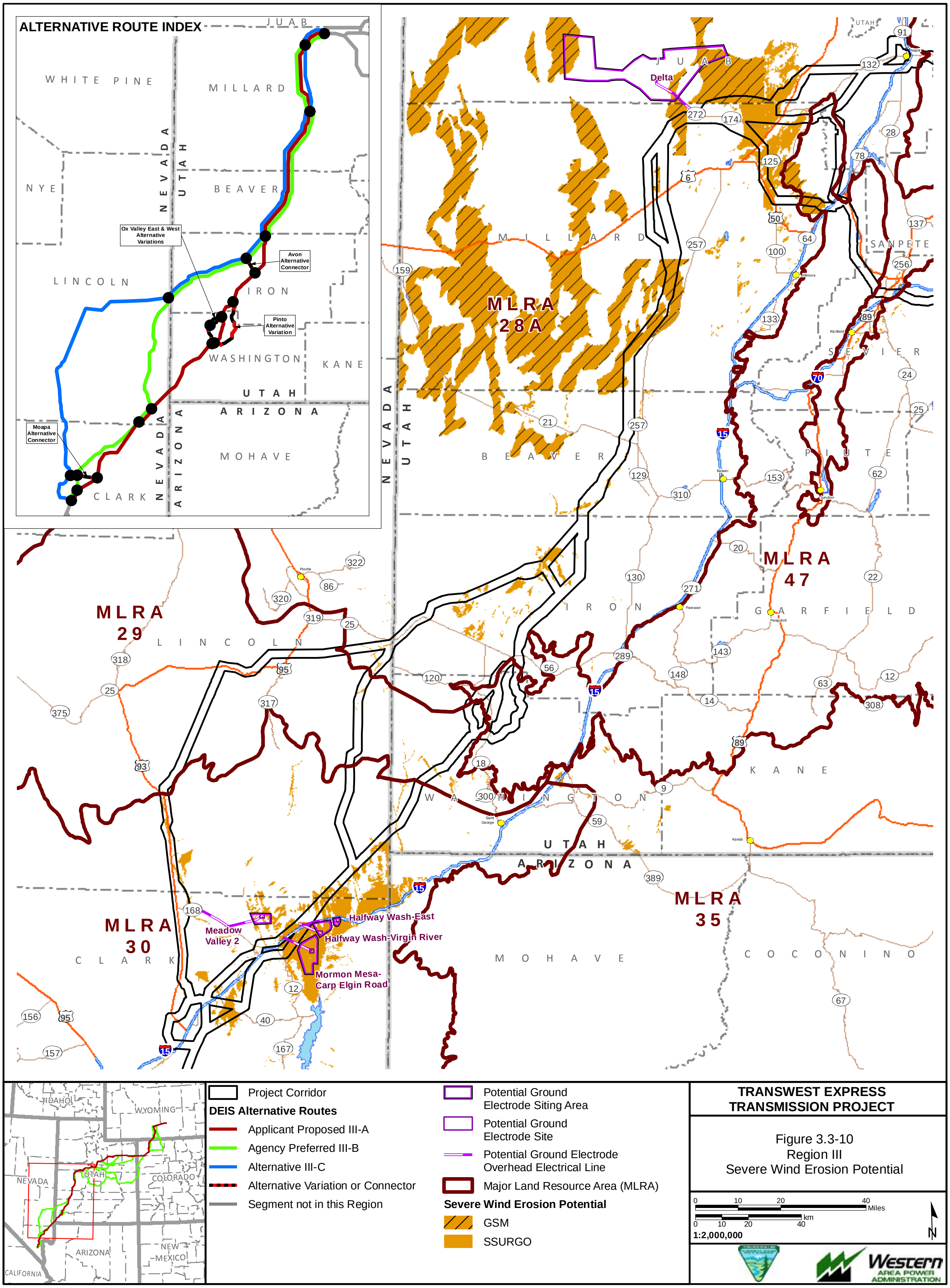

Figure 3.3-10
Region III
Severe Wind Erosion Potential

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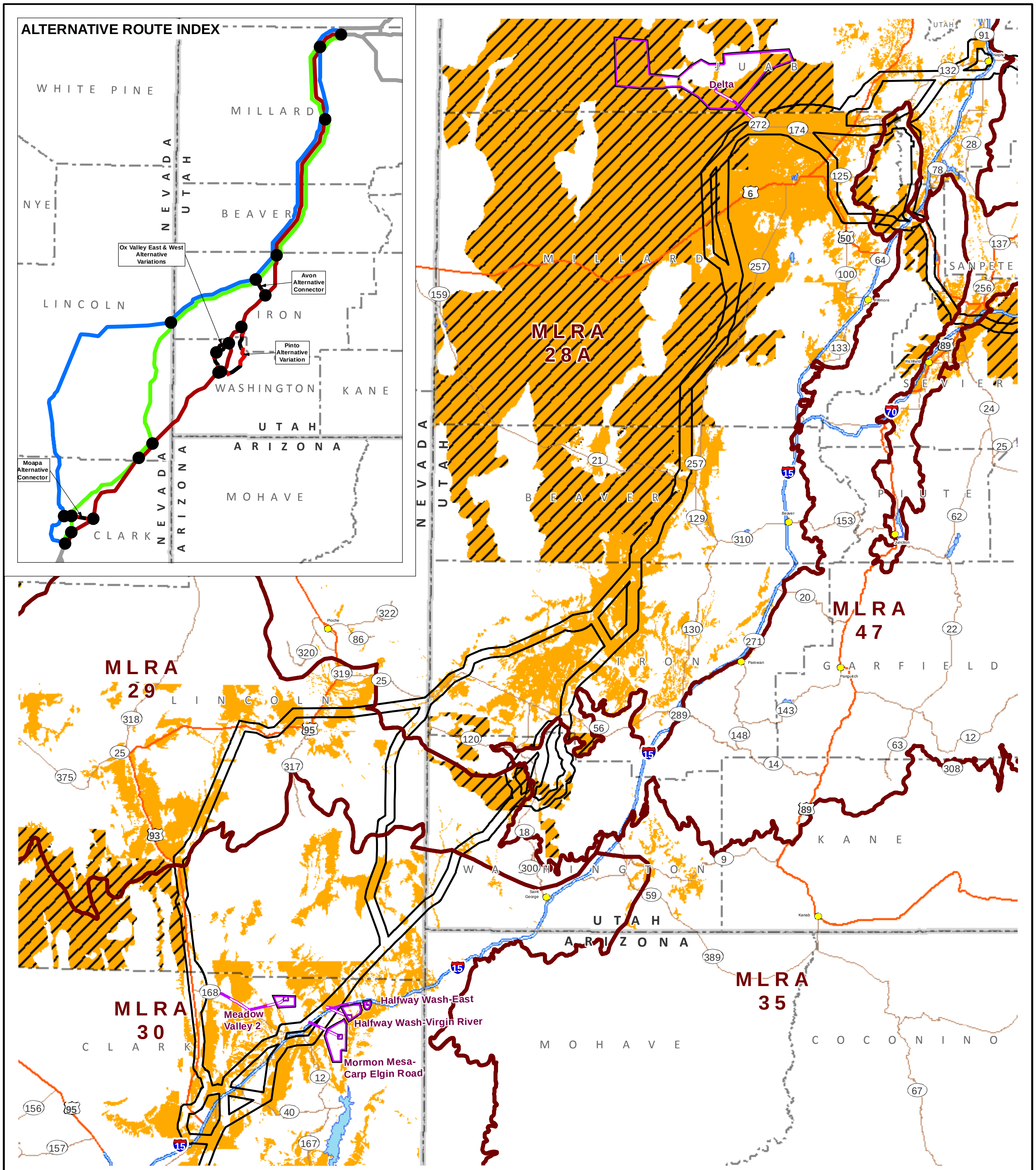
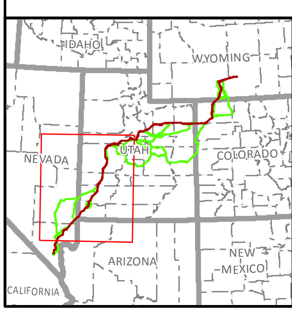




Project Corridor

DEIS Alternative Routes

- Applicant Proposed III-A
- Agency Preferred III-B
- Alternative III-C
- Alternative Variation or Connector
- Segment not in this Region

- Potential Ground Electrode Siting Area
- Potential Ground Electrode Site
- Potential Ground Electrode Overhead Electrical Line
- Major Land Resource Area (MLRA)

Limited Reclamation Potential

- GSM
- SSURGO

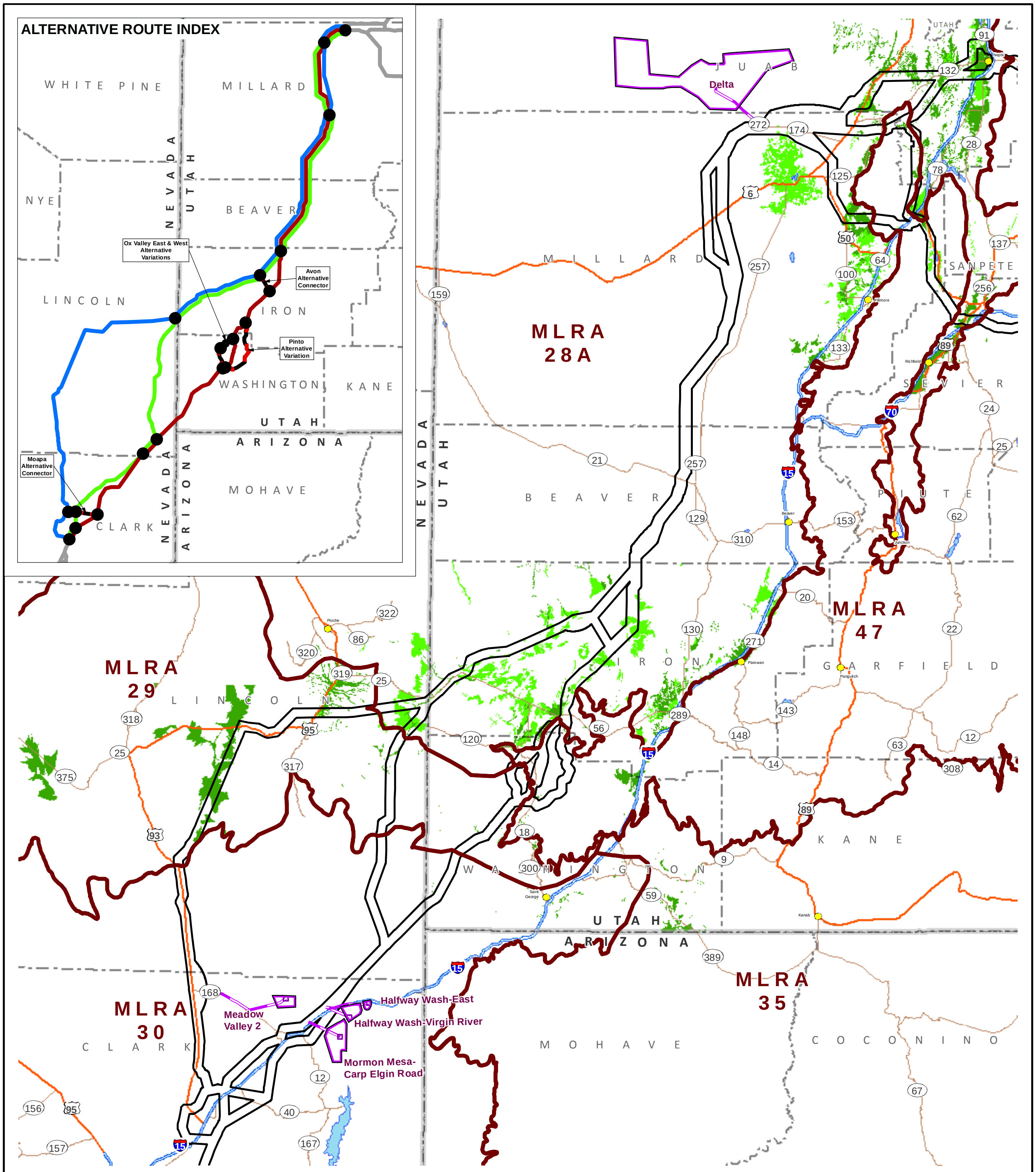
TRANSWEST EXPRESS TRANSMISSION PROJECT

Figure 3.3-11
Region III
Limited Reclamation Potential

0 10 20 40 Miles
0 10 20 40 km
1:2,000,000

Western Area Power Administration

Exported On: 6/5/2013



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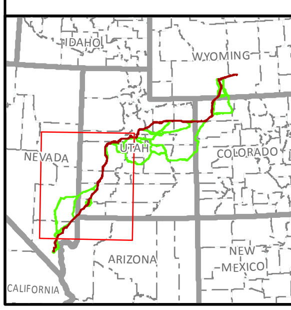

Project Corridor

DEIS Alternative Routes

- Applicant Proposed III-A
- Agency Preferred III-B
- Alternative III-C
- Alternative Variation or Connector
- Segment not in this Region
- Potential Ground Electrode Siting Area
- Potential Ground Electrode Site
- Potential Ground Electrode Overhead Electrical Line
- Major Land Resource Area (MLRA)
- Prime Farmland
- Farmland of Statewide Importance

Note: Farmland designations only available in areas with SSURGO coverage

TRANSWEST EXPRESS TRANSMISSION PROJECT

Figure 3.3-12
Region III
Prime Farmlands and Farmland of Statewide Importance

0 10 20 40 Miles
0 10 20 40 km
1:2,000,000

N

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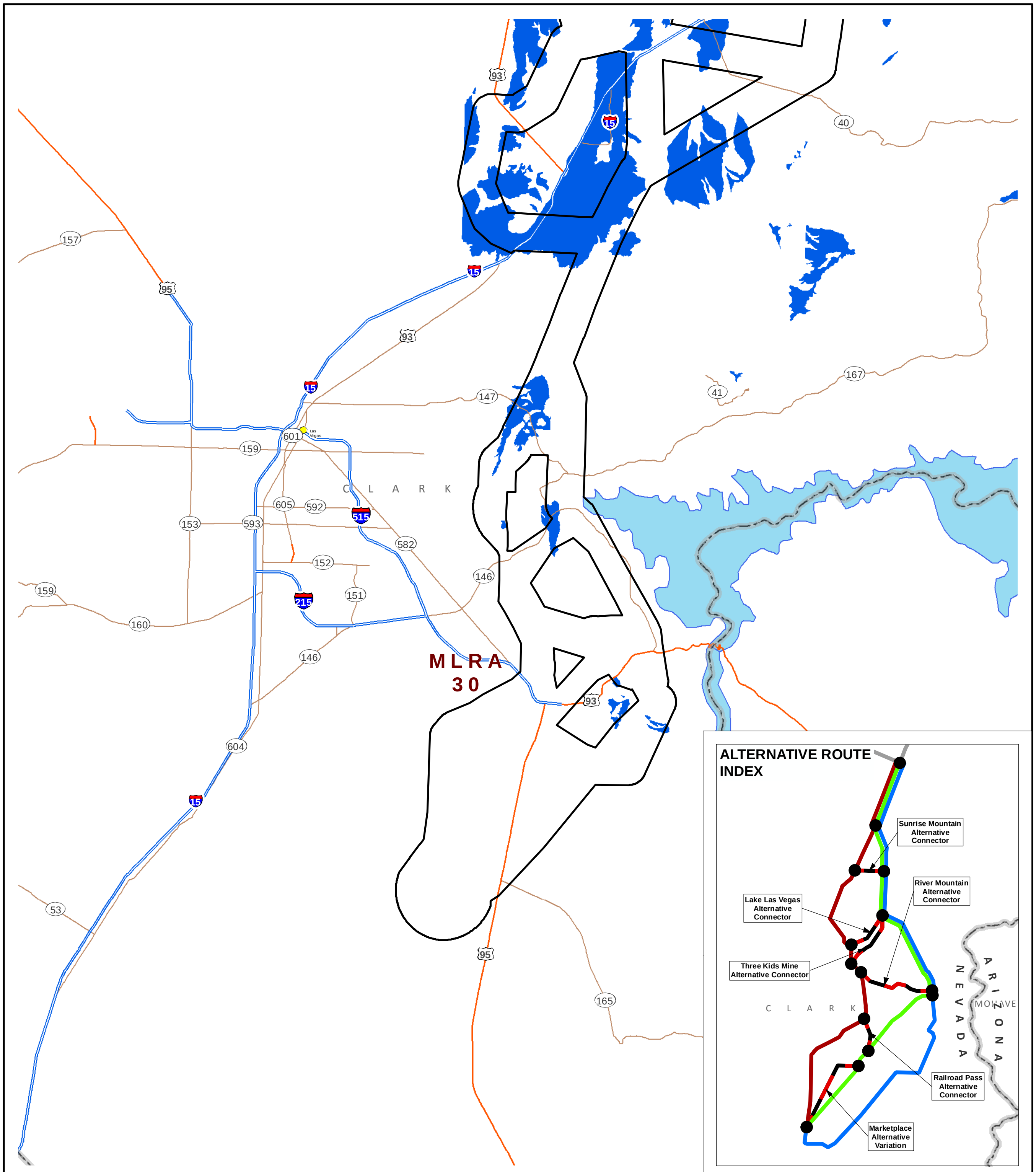

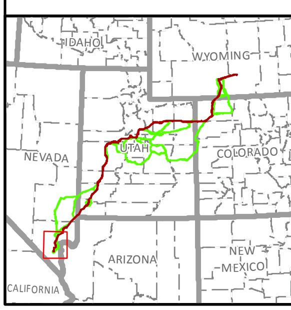

Project Corridor

DEIS Alternative Routes

- Applicant Proposed/ Agency Preferred IV-A
- Alternative IV-B
- Alternative IV-C
- Alternative Variation or Connector
- Segment not in this Region

Major Land Resource Area (MLRA)

Severe Water Erosion Potential

- GSM
- SSURGO

TRANSWEST EXPRESS TRANSMISSION PROJECT

Figure 3.3-13
Region IV
Severe Water Erosion Potential

0 2.5 5 10 Miles
0 2.5 5 10 km
1:500,000
N

Western AREA POWER ADMINISTRATION

Exported On: 4/18/2013

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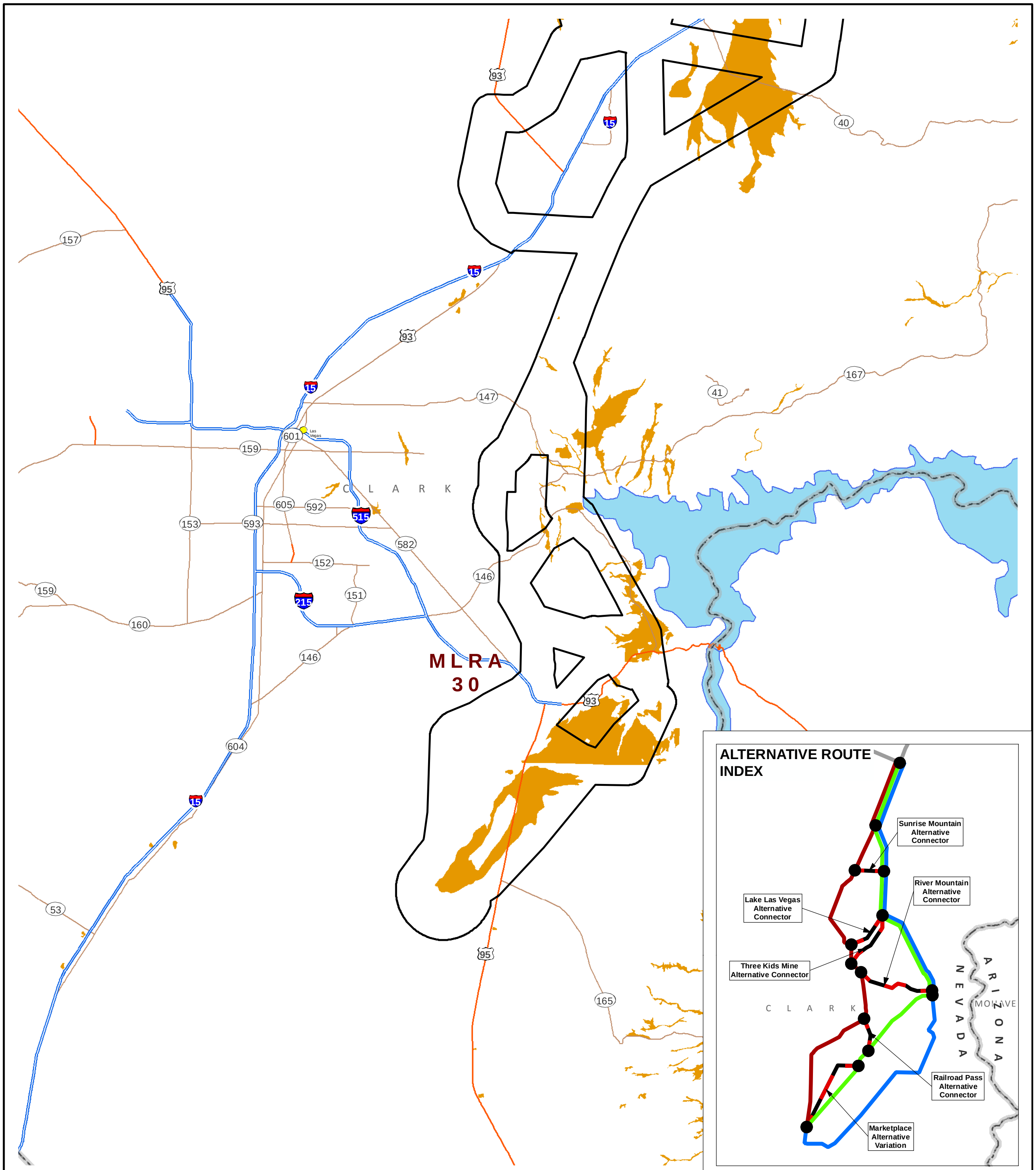

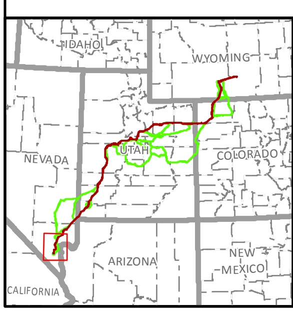

Project Corridor

DEIS Alternative Routes

- Applicant Proposed/ Agency Preferred IV-A
- Alternative IV-B
- Alternative IV-C
- Alternative Variation or Connector
- Segment not in this Region

Major Land Resource Area (MLRA)

Severe Wind Erosion Potential

- GSM
- SSURGO

TRANSWEST EXPRESS TRANSMISSION PROJECT

Figure 3.3-14
Region IV
Severe Wind Erosion Potential

0 2.5 5 10 Miles
0 2.5 5 10 km
1:500,000

N

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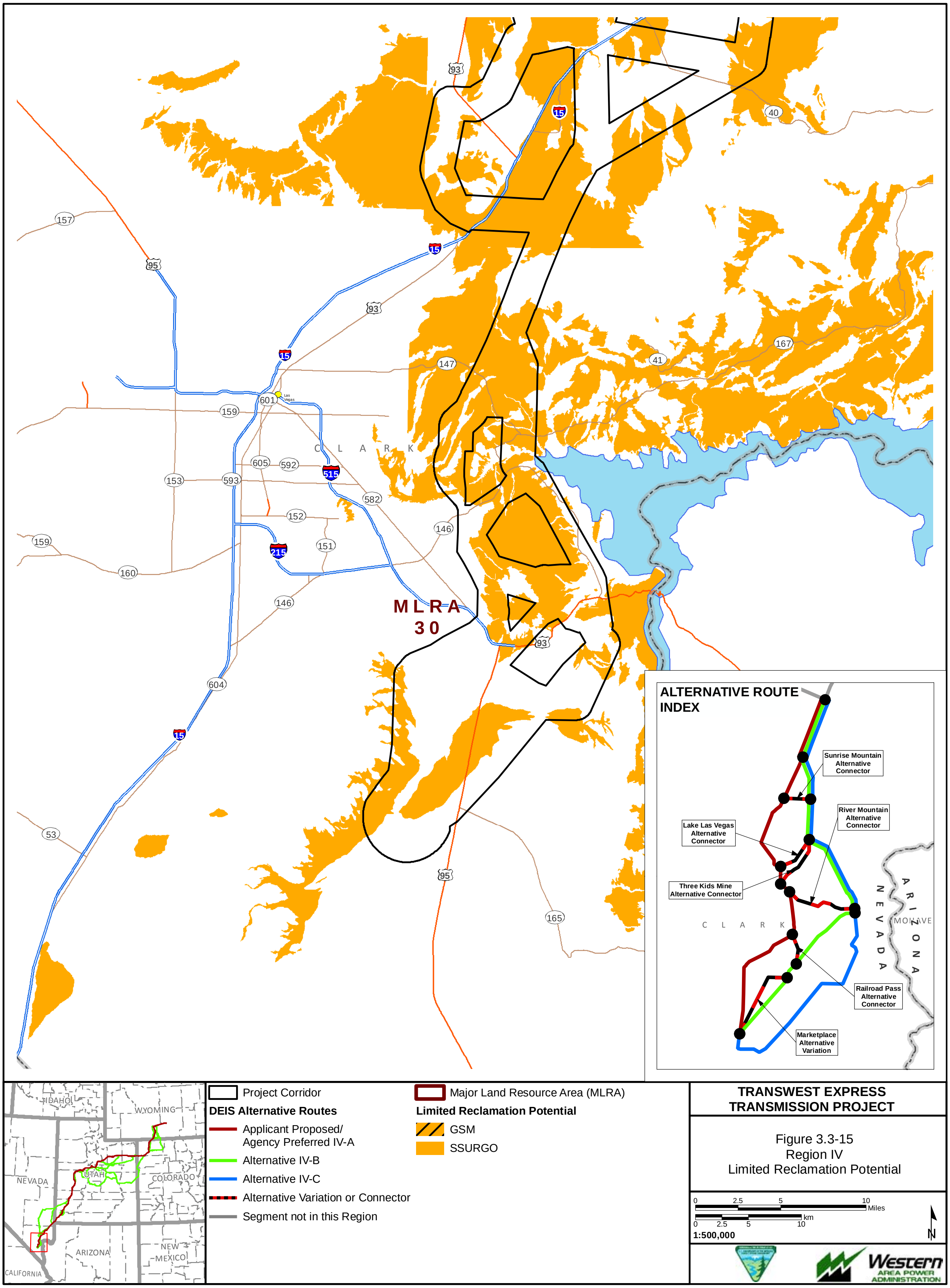

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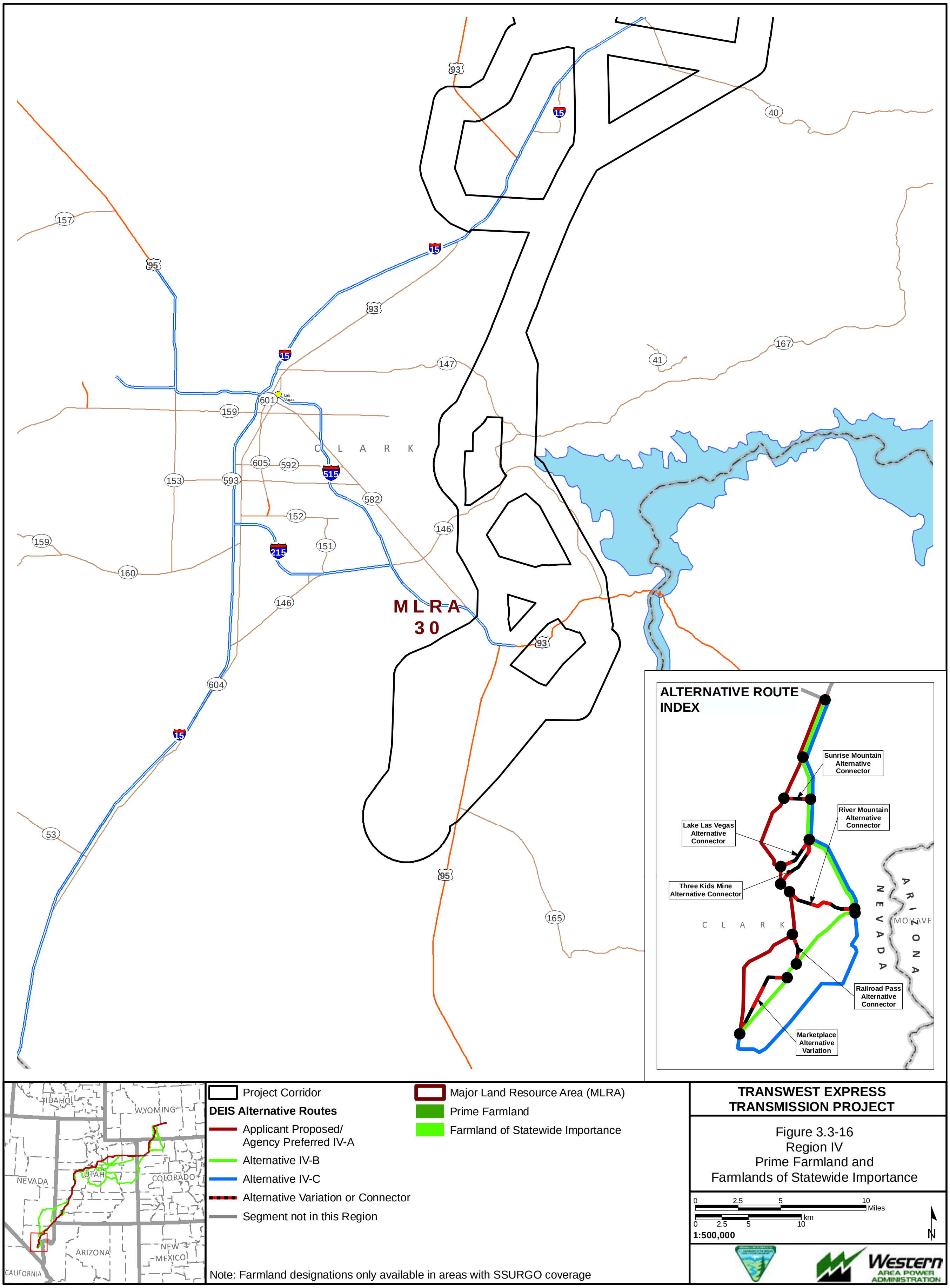

TRANSWEST EXPRESS TRANSMISSION PROJECT

Figure 3.3-16
Region IV
Prime Farmland and
Farmlands of Statewide Importance

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The methodology for evaluating impacts on soil resources involved analyzing soil survey data in relation to the proposed surface disturbance areas. To determine acres of soils disturbed by the proposed project, the known locations of proposed surface disturbances were overlain on the NRCS SSURGO order 3 soil survey layer (or GSM data where SSURGO data are unavailable) to determine the acreage of soils lost or disturbed. Temporary impacts to soils are those that are anticipated to be short-term in nature and following construction would be reclaimed and revegetated. Long-term impacts to soils would include areas where structures, surface facilities, or long-term access roads would be located for the duration of the project.

The analysis of the impacts to soil resources is based on the assumption that the TWE Project design features, WWEC BMPs, and agency use stipulations would be implemented as part of the project. These design features, agency use stipulations, and BMPs listed in **Appendix C**, address the compensation for damage to agricultural land and fences, erosion control and BMPs, recontouring, and other practices that would minimize soil resources impacts when implemented. To minimize construction related impacts to soil resources, reclamation would be conducted as soon as practical following surface disturbance. Additionally, TWE would be required to abide by the goals, objectives, and management actions outlined in each BLM RMP, and the standards and guidelines in each USFS LRMP. The respective resource management plans for each land management agency crossed by the proposed project are listed in Chapter 1.0, **Table 1-3** and **Table 1-4**.

Third-party Environmental Compliance Monitors (ECMs) would be on-site during construction. These ECMs would be responsible for making sure TWE is in compliance with all applicable recommended mitigation measures, agency use stipulations and requirements, BMPs, and design features.

Issues related to soil resources as identified during the scoping process include the following:

- Disturbance and potential loss of biological soil crusts;
- Soil disturbance during construction activities resulting in accelerated soil erosion, exposed soils, the potential for mass failure, and reduced soil productivity; and,
- Potential for successful reclamation of soils with physical or chemical reclamation constraints.

Relevant management considerations are shown in **Table 3.3-2**.

Table 3.3-2 Relevant Analysis Considerations for Soils

Resource Topic	Analysis Considerations and Relevant Assumptions
Soil Quality and Productivity	Any surface disturbance has the potential to degrade soil quality and productivity because it damages the biological soil crust and exposes the bare soil to the erosive forces of wind and water until vegetation or other ground cover is established.
Soil Erosion	Bare soil (without vegetation or other surface cover) with a surface layer that has been altered from its natural condition is more susceptible to accelerated wind and water erosion than undisturbed soil. Erosion from disturbed areas would be minimal once vegetation is reestablished. Successful establishment of vegetation generally takes a minimum of 3 to 5 years, depending on soil and precipitation, and requires monitoring during this time.
Soil Stability	Surface disturbance from construction would modify soils by disrupting soil stability, changing vegetative cover that can reduce nutrient recycling, damaging biological crusts, decreasing productivity, and increasing compaction.
Sensitive Soils	Sensitive soils, including those that are highly erodible, have a high pH, high salinity or sodicity, have a high clay content, occur on steep slopes of 35% or more, or have a limited revegetation potential, would incur greater adverse impacts from surface-disturbing activities than non-sensitive soils.
Soil Standards	The Standards for Public Land Health (BLM 1997) provide minimum standards for vegetation health, vigor, soil cover, and erosion rates that apply to all BLM administered activities.

Table 3.3-2 Relevant Analysis Considerations for Soils

Resource Topic	Analysis Considerations and Relevant Assumptions
Highly Erodible Soils	When surface disturbance occurs on highly erodible soils, the potential for accelerated erosion is greater than on less erodible soils. The risk of BMP failure is greater on highly erodible soils. To be effective on highly erodible soils, more extensive BMPs and more aggressive maintenance techniques than those commonly used are often required.
Soil Compaction	Operating motorized vehicles on moist soils, especially heavy equipment, is likely to cause compaction of the surface layer, which may increase runoff, decrease infiltration and aeration, and reduce soil productivity by making it more difficult for plant roots to establish or obtain soil moisture and nutrients.
Soil Data	Impact analysis with order 3 SSURGO data is more accurate and detailed than analysis with U.S. GSM data. GSM data has not been field verified and does not have interpretive data associated with prime farmlands, hydric soils, shallow excavations limitations, or small commercial buildings limitations and acreage associated with these would be zero.

3.3.6.1 Impacts from Terminal Construction, Operation, and Decommissioning

The northern and southern terminals would be constructed regardless of alternative route or design option. **Table 3.3-3** summarizes the soil characteristics of soils within the disturbance footprint of the Northern and Southern terminals and Design Options 2 and 3.

Northern Terminal

Construction of the Northern Terminal would disturb approximately 504 acres of soils. A permanent loss of soil resources would be expected on approximately 234 acres for the permanent Project facilities. Approximately 270 acres would be temporarily disturbed for construction work areas. **Table 3.3-3** summarizes the soil characteristics of soils within the disturbance footprint of the Northern Terminal.

The northern terminal is proposed to be constructed on relatively undisturbed uplands. Grading may be required to create a level working surface. Where the topography is relatively flat and grading occurs, it would be limited to the upper subsurface soil horizons. Where cut and fill slopes occur, the soil profiles would be mixed with a corresponding loss of soil structure. Mitigation measure **S-1** is recommended to prevent topsoil mixing with subsoil and to promote successful revegetation during decommissioning. If soils are saturated or frozen when grading or soil salvage activities occur, it could result in improper topsoil segregation due to difficulty with soil handling. Reapplication on or of frozen soils could result in voids or collapses as the soil defrosts. Mitigation measure **S-2** is recommended to mitigate impacts associated with working with frozen or saturated soils. BMPs that would reduce impacts to soil resources during construction include: SOIL-1 (salvage, safeguard, and reapply topsoil from all excavations and construction activities) and AIR-1 (cover construction materials and stockpiled soils if these are sources of fugitive dust). In general most topsoil stockpiles would be temporary and short-term. However at project facilities, a decrease in soil productivity would occur in association with soil salvage and stockpiling activities as microbial action is curtailed, at least to some degree, in the constructed long-term stockpiles.

***S-1**: Where permanent facilities or structures would be located, the entire topsoil horizon would be salvaged for use in reclamation, prior to surface disturbance. Topsoil would be spread evenly around the permanent structure (not left in piles) and revegetated for future use.*

Effectiveness: Salvaging all topsoil from locations where permanent facilities or structures would be located, would increase the potential for successful reclamation during decommissioning.

***S-2**: Construction, excavation, or re-spreading with frozen or saturated soils would be prohibited.*

Effectiveness: BMPs prohibit topsoil stripping when soils are saturated or frozen. Through the implementation of measure **S-2**, impacts to soils due to uneven settling, compacted surfaces, and physical crusts reducing water infiltration would be avoided. Through the implementation of mitigation measure **S-3** and BMPs, impacts to soils from grading activities would be effectively reduced.

Soil compaction would result from the movement of construction vehicles on roads and temporary work areas. Soil compaction would impact the upper profile subsoils immediately beneath the road and construction work surface, but also would impact subsurface soils at a greater depth if fine textured soils are present. Soil compaction would result in a corresponding loss of infiltration, permeability, and soil aeration. An increase in runoff and erosion would be expected on bare, compacted soils at construction work areas. BMP WAT-9 would require control of erosion using techniques such as silt fences, water bars, hay bales, or erosion berms; this would reduce soil erosion off site. BMP SOIL-5 would require compacted soils to be chiseled or ripped, which would help to reduce the impacts associated with compaction. Temporary work areas would be reclaimed and revegetated following construction. These impacts, along with a loss in soil productivity, would occur for the duration of project construction and until successful reclamation is achieved. Additional mitigation measure **S-3** is recommended to further mitigate compaction impacts during reclamation.

S-3*: During reclamation, compacted areas (typically any area that receives repeated traffic or 3 or more passes by heavy equipment) will be decompacted, to the depth of compaction, by subsoiling, paraplowing, or parabolic ripping on the contour to the depth of compaction. This would help prepare the seed bed, encourage infiltration and help to prevent accelerated runoff and erosion. Scarification would only be used on shallow soils. Compaction depth would be determined on a case by case basis, by a qualified environmental inspector or soil scientist.*

Effectiveness: Decompacting to the depth of compaction reduces the potential for buildup of alkalinity, salts, or sodium over a subsurface compacted layer. Additionally, it prevents water from infiltrating and flowing laterally once it hits a deep compacted layer, carrying surface soils away, or causing instability of saturated soils on slopes. Site specific permanent impacts to soil quality and productivity would be expected from terminal construction where permanent facilities are located. Through the implementation of the design features, BMPs, agency use stipulations, additional mitigation and considering the upland locations of the terminals, little to no impacts related to erosion and sedimentation are expected.

Southern Terminal

Construction of the Southern Terminal would disturb approximately 412 acres of soils. A permanent loss of soil resources would be expected on approximately 203 acres for the permanent Project facilities. Approximately 209 acres of soils would be temporarily disturbed for construction work areas. Similar impacts would be expected as described for the Northern Terminal. There is a proposed location and an alternative location for the southern terminal. The alternative location would impact more LRP soils than the proposed location for the southern terminal, and therefore may pose more revegetation and reclamation challenges than the proposed terminal location. **Table 3.3-3** summarizes the soil characteristics of soils within the disturbance footprint of the Southern Terminal.

Site-specific permanent impacts to soil quality and productivity would be expected from terminal construction. Through the implementation of the design features, BMPs, and mitigation measure **S-1**, and considering the upland locations of the terminals, little to no impacts related to erosion and sedimentation are expected.

Design Option 2 – DC from Wyoming to IPP; AC from IPP to Marketplace Hub

Under Design Option 2, the location of the Southern Terminal would change. Design Option 2 would result in similar acres of initial and permanent disturbance to soil resources as described for the Proposed Action. Impacts would be similar to what is described in Section 3.3.6.2, Impacts Common to all Alternative Routes and Associated Components, except the Southern Terminal, Delta Ground Electrode Site, and AC/DC converter station would be located at IPP instead of the Marketplace Hub. Acreages of

Table 3.3-3 Soil Characteristics within the Disturbance Footprint of the Northern and Southern Terminal, Design Option 2 Terminal, and Design Option 3 Substation (acres)

Project Components	Region	Wind Erodible	Water Erodible	Compaction Prone	LRP	Hydric	Shallow Bedrock	Risk of Corrosion to Concrete	Risk of Corrosion to Steel	Shallow Excavations	Small Commercial Buildings	Expansive Soils
1-Northern Terminal Siting Area	I	718	917	992	2,500	0	75	0	4,422	0	0	229
1-Northern Terminal	I	23	87	91	114	0	3	0	229	0	0	22
4-Southern Terminal Siting Area	IV	472	0	0	2,031	0	15	278	3,527	3,416	3,527	0
4-Southern Alternative Terminal	IV	0	0	0	74	0	0	0	74	74	74	0
4-Southern Terminal	IV	0	0	0	0	0	0	0	78	78	78	0
3-Southern Terminal Siting Area near IPP (DO2)	III	211	0	463	1,100	0	0	1,100	1,100	637	319	463
3-Southern Terminal near IPP (DO2)	III	0	0	18	18	0	0	18	18	0	0	0
3-Substation near IPP (DO3)	III	0	0	43	43	0	0	43	43	0	0	0

[1] Limited Revegetation Potential.

Source: NRCS 2011.

surface disturbance would be similar; however, the location of disturbance would change. Similar impacts would be expected as described for the Northern Terminal. The southern substation at Eldorado Valley would be sited within one of the two terminal sites as described under the proposed action, therefore impacts would be the same as described for the proposed action.

Design Option 3 – Phased Build Out

Under Design Option 3, an additional substation would be constructed. Construction of Design Option 3 would entail construction of an additional Substation near IPP. Design Option 3 would result in the same acres of disturbance to soil resources as described for the Proposed Action. The phased build out would result in similar impacts to soil resources as described in Section 3.3.6.2, Impacts Common to all Alternative Routes and Associated Components. Phasing the construction would not have a direct effect to impacts on soil resources.

Operation Impacts

Because the entire site would be treated with a soil sterilizer (to prevent vegetation growth) and graveled, soil productivity and quality would be permanently altered. Soil compaction within the fenced areas and access road would continue due to continued movement of operation and maintenance vehicles and equipment. Soil contamination could occur due to potential spills. A Spill Prevention, Notification, and Clean-up Plan would be prepared as part of the COM Plan (TWE-57). Runoff and erosion would increase due to maintained compaction; however the BMPs described above for construction would help to reduce these impacts. In addition, BMPs PHS-9 through 17 would reduce the potential for hazardous waste release.

Decommissioning

If a terminal, substation, or regeneration station is no longer required, the buildings, structures and equipment would be dismantled and removed from the site. Reclamation of terminals and substation facilities would be difficult due to the sterilization of soils. Long-term topsoil stockpiles would result in a decrease in soil productivity and quality in the constructed long-term stockpiles. BMP GEN-14 would require the removal of gravel work pads. Additional mitigation measures **S-1**, **S-2**, **S-3**, and **S-4** are recommended to further mitigate impacts during reclamation and decommissioning.

S-4*: During decommissioning, where a soil sterilizer has been applied, sterile soils will be removed prior to the replacement of topsoil and seeding.*

Effectiveness: Removing chemically sterile soils before applying topsoil would help with revegetation success, should a terminal be decommissioned. Long-term soil quality and productivity would be altered at these sites, but through the application of BMPs, applicant committed design features, and additional mitigation, revegetating and reclaiming these sites to their original uses would be possible.

3.3.6.2 Impacts Common to all Alternative Routes and Associated Components

Potential direct and indirect effects related to construction, operation, maintenance, and decommissioning on soil resources are discussed below. If impacts remain after the application of applicant committed design features and BMPs and stipulations, additional mitigation is recommended to reduce or mitigate impacts.

Construction Impacts

In general, the impacts associated with construction of the transmission line would be temporary. Temporary disturbances would occur within the 250-foot-wide transmission line ROW from construction traffic along the ROW, material storage yards, batch plant sites, temporary staging areas, and work areas around each structure.

Direct impacts to soil resources would include the clearing or crushing of surface cover within the 250-foot-wide transmission line ROW (vegetation, duff, litter). Vegetation clearing would consist of cutting all vegetation over 6 feet in height within the 250-foot-wide transmission line ROW and leaving the stumps in place for erosion control. Trampling is defined as leaving vegetation under 6 feet in height in the 250-foot-wide transmission line ROW, and driving over the vegetation with construction equipment. Where woody material is chipped and left on the 250-foot-wide transmission line ROW, it may act as erosion control, providing the wood chips do not exceed 3 inches in depth. The effects of wood chip additions (at a 3-inch depth) on the soil resource include: increased soil temperature in the winter, moderate increase in soil moisture, and substantial decrease in soil nitrogen supply and understory vegetation. The increase in soil temperature and soil moisture would have relatively minor ecological effects. However, reductions in the soil N supply may temporarily reduce productivity of the soil and affect revegetation rates (Binkley et al. 2003). With increasing depth of woodchips, these impacts will increase in magnitude and duration.

Grading and leveling would be required to construct structures and for temporary work areas, staging areas, fly yards, and concrete batch plants, with the greatest level of effort required on more steeply sloping areas. During construction, the soil profiles would be mixed with a corresponding loss of soil structure. BMPs that would reduce impacts associated with grading include:

- SOIL-1 requires the salvage, safeguarding, and reapplication of topsoil from all excavations and construction activities.
- SOIL-2 requires site-specific and specialized construction techniques for areas of steep slopes, biological soil crusts, erodible soil, and stream channel crossings.
- SOIL-3 requires the applicant to backfill foundations and trenches with originally excavated material as much as possible. Excess excavation materials should be disposed of by the applicant only in approved areas.

Soil compaction would result from the movement of heavy equipment and vehicles during construction activities. Soil compaction and a reduction in ground cover would lead to an increase in bulk density, increased runoff, and erosion. Mitigation measure **S-1**, **S-2**, and **S-3** would help to prevent or mitigate compaction to the depth of compaction, as described in Section 3.3.6.1. Rutting or soil mixing could occur when soils are saturated. Rutting affects the surface hydrology of a site as well as the rooting environment. The process of rutting reduces the aeration and infiltration of the soil, thereby degrading the rooting environment. Rutting may result in soil mixing of topsoil and subsoil, thereby reducing soil productivity. Rutting also disrupts natural surface water hydrology by damming surface water flows or by diverting and concentrating water flows creating accelerated erosion. Soil mixing typically results in a decrease in soil fertility and a disruption of soil structure. Additional mitigation measure **S-5** would help to reduce the potential for rutting and soil mixing. The potential for erosion would increase through the loss of vegetation cover as compared to an undisturbed state. Reclamation and erosion control would be difficult on soils that occur on steeper sloping areas (15 percent or more), particularly those steeper sloping areas over shallow soils (20 inches or less to bedrock). Steep slopes crossed by the project alternatives are shown in Section 3.2 on **Figures 3.2-2**, **3.2-6**, and **3.2-11**.

S-5*: Surface activities are prohibited when soils or road surfaces become saturated to a depth of 3 inches or less if mixing of the topsoil and subsoil will occur or the soil surface becomes unsafe for vehicular travel.*

Effectiveness: This measure would reduce the potential for mixing of topsoil and subsoil and reduce the potential for soil displacement, compaction, and rutting.

Soils with unfavorable properties, including thin topsoil layers, moderate to strong salinity and alkalinity, very clayey or sandy surface or subsoils, and shallow depths over bedrock are common and would present problems for erosion control and revegetation. Badlands also would present reclamation challenges due to the difficulty in stabilization of disturbances in these areas. Based on structure spacing of 700 to 1,500 feet, sensitive areas (such as hydric soils or badlands) could generally be spanned.

Surface restoration would occur as required by the landowner or managing agency, returning the disturbed areas back to their natural contour, reseeding, and installing erosion control if necessary (TWE 13). Runoff from excavated areas would be controlled (TWE 22). Areas that do not require re-contouring would have vegetation left in place wherever possible to maintain vegetation roots and increase soil stability (TWE 27). BMPs such as silt fences and check dams would further minimize this impact by trapping sediments or slowing the flow (BMP WAT-9).

S-6*: During construction, erosion control measures will be inspected after every storm event and maintained.*

Effectiveness: Erosion controls are only effective if they are maintained. Monitoring of erosion controls after storm events would keep erosion control in effective working order and reduce or prevent sediment from moving off-site. Implementation of design features, BMPs, and mitigation measure **S-6** would effectively control erosion from disturbed areas reducing the loss of surface soils and potential sedimentation effects.

Long-term impacts to vegetation are anticipated associated with regular vegetative clearing, specifically in areas with deciduous or coniferous tree species. Modifying vegetation types (e.g. converting a forested area to grass) would modify soil productivity and soil development. BMPs REST-1 and -2 would require reclamation of vegetation, species composition, and diversity. Although long-term soil productivity would be altered, nutrient cycling would continue due to the continual addition of leafy vegetative litter associated with grass or shrub species.

While the exact locations of access roads are not known, general impacts associated with construction of access roads are described in the subsequent text. Access road construction typically would occur within the 2-mile transmission line corridor as described in **Appendix D**, Section 3. A summary of soil characteristics within the corridor is provided in the discussion specific to each region below. Construction of new access roads would begin with vegetation removal. Smaller vegetation would be lopped and scattered outside the road construction area. For bladed roads, topsoil would be removed and salvaged from the road construction area as required by the appropriate land management agency or private landowner. Topsoil would be stored adjacent to the road or in a nearby workspace. Topsoil would be prone to erosion until adequate erosion controls are applied or topsoil piles are revegetated. Where the topography is relatively flat and grading occurs, soil mixing would be limited to the upper subsurface soil horizons. Where cut and fill slopes occur, the deeper subsurface soil profiles would be mixed with a corresponding loss of soil structure. Soil compaction would considerably impact the upper profile subsoils immediately beneath the road surface but also would impact subsurface soils at a greater depth if fine textured soils are present. Soil compaction would result in a corresponding loss of infiltration, permeability, and soil aeration. Runoff and soil erosion would increase as a result of compaction, particularly on steeper grades such as Category 5 and 6 roads described in **Appendix D**, Section 3. Where road surfacing is applied, this impact would be reduced. As needed, the access roads would be bladed/graded to allow for safe access and construction, which would loosen soils and make them susceptible to erosion. An indirect effect of new access roads is an opportunity for increased access by recreational users. Where public access is increased an increase in bare ground would be expected, along with additional compaction, erosion, sedimentation, and a decline in soil quality.

TWE has committed to install appropriate erosion control devices to prevent erosion or loss of the topsoil, including measures to prevent wind erosion and fugitive dust, and silt fencing to prevent sediment runoff. In addition, TWE has committed to develop an Erosion Control Plan (TWE-19). Access road construction would be avoided on steep hillsides and near watercourses where alternate routes provide adequate access. Where long term surface occupancy occurs (facility sites, permanent roads, etc.), access roads would be upgraded and maintained as necessary to prevent soil erosion and accommodate year round traffic; all disturbed areas unnecessary to operations would be stabilized, and all disturbed areas outside the work area would be seeded with an agency approved seed mixture. Erosion controls such as jute netting, silt fences, and check dams would further minimize erosion and sedimentation impacts (WAT-9).

***S-7**: Permanent access roads would not be constructed on slopes over 25 percent.*

Effectiveness: Accelerated erosion and road failure increases on steep slopes. This mitigation measure is a preventive measure to reduce impacts associated with access roads. Implementation of mitigation measures, design features, and BMPs would effectively reduce or minimize runoff and accelerated erosion from roads.

***S-8**: Temporary and permanent access roads would be gated to restrict motorized use by the public. In some instances, other methods may need to be employed to prevent public access. After construction is complete, permanent access roads would remain gated at the land management agency or landowner's discretion. If the road is no longer needed for operations, it would be obliterated with the following procedures:*

1. Remove all stream crossings and restore stream banks to natural contours;
2. Reestablish natural drainage patterns;
3. Decompact the road surface by subsoiling along the entire disturbed length;
4. Recontour the road prism to the original land contours;
5. Seed with an agency or landowner approved seed mixture; and
6. Gates and closure signage should be left in place until adequate regeneration/rehabilitation occurs.

Effectiveness: Implementation of gating and other closure methods would help to reduce public access and impacts associated with trespass.

Borrow pits would be stripped of topsoil to a depth of approximately 6 inches. Stripped topsoil would be stockpiled and, upon completion of borrow excavation, spread to a uniform depth of 6 inches over the areas from which it was removed. Before replacing topsoil, excavated surfaces would be reasonably smooth and uniformly sloped. The sides of borrow pits would be brought to stable slopes with slope intersection shaped to carry the natural contour of adjacent undisturbed terrain into the pit to give a natural appearance. When necessary, borrow pits would be drained by open ditches to prevent accumulation of standing water. Topsoil excavation, transport, storage, and redistribution would modify existing microbial populations and soil structure, generating adverse impacts relative to aeration and permeability. It is likely that some mixing of textural zones would occur. Topsoil would be re-spread over the remaining subsoils and seeded. Subsoils in the arid west have the potential to have an increase in saline, sodic, and/or strongly alkaline materials. Depending on the amount of topsoil that is re-spread, this may create adverse chemical impacts to soils for seedbeds. Due to these probable effects, the initial soil quality of reconstructed seedbeds and root zones would be less than that of the existing soil resources. Agency BMPs would require the applicant to obtain borrow (fill) material only from authorized sites. Existing sites should be used in preference to new sites. One BMP (see **Appendix C**) requires all suitable topsoil to be stripped from the surface of the location and stockpiled for reclamation once the location is abandoned. When topsoil is stockpiled on slopes exceeding five percent, construct a berm or trench below the stockpile. BMP SOIL-4 would require the applicant to obtain borrow (fill) material only from authorized sites. Existing sites would be used in preference to new sites. Although topsoil would be stripped at all disturbed sites there is still potential for site specific impacts to soil quality at borrow sites. Additionally, a depression would be left ultimately changing the hydrologic regime at the site.

Soil contamination could result from material or fuel spills during construction activities. If large spills occur, contamination could result in the removal and disposal of large amounts of soil. Saturated soils have the potential to disperse contaminants to groundwater or surface water. BMPs PHS-9 through -17 and design features TWE-57 through -62 would reduce the potential for hazardous waste release along the ROW. The application of design features and BMPs would help to reduce the risk of an accidental spill or release of hazardous materials. The BMPs and design features may not fully prevent soil contamination, but they would reduce the potential for soil contamination and help to meet state and federal requirements.

Construction of the transmission line would result in areas of localized permanent impacts associated with the structure foundations and regeneration sites. Localized long-term impacts to soils would result from loss of surface lands and soil productivity and quality due to installation of structure foundations. Losses of prime farmland could occur if structure foundations or facilities are required in prime farmlands. Acreage of permanent disturbance associated with each alternative is described in Section 3.3.6.9, Irreversible and Irretrievable Commitment of Resources.

In areas where single shaft tubular steel pole structures are used, increased volumes of excavated subsoil spoils may require spreading beyond the general disturbance area. In these areas, topsoil would be salvaged and set aside to be placed over the subsoil material during restoration. Spoil material would be used for backfill where suitable, and the remainder would be spread at the structure site or along graded access roads or in locations previously agreed upon by the Applicant and the appropriate land management agency or private landowner. Subsoils in the arid west are commonly characterized as having high pH, salts, and sodium. If excess subsoils are spread or redistributed on the soil surface undesirable chemical or physical soil characteristics could create adverse impacts to soil quality for seedbeds and reclamation. BMP SOIL-1 would require TWE to salvage, safeguard, and reapply topsoil from all excavations and construction activities. Additionally foundations and trenches must be backfilled with the originally excavated material to the extent possible. Excess excavation materials should be disposed of by the applicant only in approved areas (SOIL-3).

S-9*: Excess subsoil that is excavated for foundations would not be spread on the soil surface (on top of topsoil) or on access roads. Excess subsoil would be disposed of in accordance with federal, state, and local requirements.*

Effectiveness: If soil mixing of topsoil and subsoil is successfully prevented the soil quality and productivity of native topsoil would be maintained. Implementation of BMPs and mitigation measure **S-9** would prevent the contamination or dilution of topsoil with physical or chemically unsuitable subsoil materials.

These following project facilities would be within the 250-foot-wide transmission line ROW and the soils encountered at these sites are discussed by region and alternative below. Two ground electrode facilities are proposed, one connecting to the Northern Terminal and one connecting to the Southern Terminal. The ground electrode facilities would result in a long-term soil disturbance of approximately 0.5 acre at each location. The center of the electrode containing the control house would be fenced. Permanent impacts to soil quality and productivity would be expected within the fenced area. The ground electrode site at Mormon mesa is situated on old soils that contain thick petrocalcic horizons. Over time carbonates have been transported into the subsoil by water that precipitates the carbonates in the subsoil upon evaporation, eventually forming a massive, continuous layer of cemented carbonates. These soils may pose construction challenges and would be corrosive to concrete and metal. Agricultural land uses outside the fenced area, such as grazing and cultivated crops, would be permissible.

Communication regeneration sites would consist of small buildings located within a fenced graveled site. In total, approximately 15 to 20 regeneration sites would be required for the proposed TWE Project. In most cases, the regeneration communication sites would be located within the 250-foot-wide transmission line ROW and typically would be 100 feet by 100 feet in size. The communication regenerations sites would result in a long-term disturbance to soil resources due to the soils being taken out of production and compacted resulting in a long-term loss of soil productivity.

At the conclusion of construction activities, TWE has committed to disk compacted soils in cultivated agricultural areas and scarify road surfaces being reclaimed. Disking does not mitigate compaction, but would break up large soil clods near the surface and help to prepare the seed bed. Scarification breaks up the surface layer of soil and is not an adequate decompaction tool except on shallow soils. On deeper soils, compaction would remain at depth and water would infiltrate through the soil surface but would not penetrate the compacted subsoil layer. This would result in a lateral subsurface flow of water, which could carry surface soil with it on sloping areas. In addition, **S-3** would require decompaction to the depth of compaction. Additionally, GEN-14 would require the removal of gravel work pads that were used during construction.

At all permanent facilities, BMP SOIL-1 would require topsoil salvage, safeguarding, and reapplication from all excavations and construction activities. GEN-14 would require the removal of gravel work pads that were used during construction. AIR-1 would help to protect salvaged topsoil from erosion and degradation.

S-10*: Prime farmlands will be avoided to the extent possible for permanent project facilities and structure foundations.*

Effectiveness: Avoidance of prime farmlands for structures or permanent Project facilities would reduce but not fully mitigate the loss of prime farmlands. It may not be possible to completely avoid prime farmlands. Where Project facilities or structure foundations impact prime farmland, the soil resources would be lost and permanently removed from production.

Interim reclamation would occur after construction activities are complete. Reclamation failure, consisting of unsuccessful revegetation efforts, substantial soil erosion, or slumping, would be handled in accordance with each agency's specific guidelines (**Appendix C**) or landowner requirements.

<u>Operation Impacts</u>

Traffic on native surface roads during operations would result in soil compaction or rutting if soils are saturated. Rutting occurs when the soil strength is not sufficient to support the applied load from vehicle traffic. Rutting disrupts surface water hydrology by diverting and concentrating water flows and would cause accelerated erosion and sedimentation to connected waterbodies. If permanent access roads do not have adequate erosion controls or the roads are not properly maintained, the roads would degrade and erode. Where long-term access is required for maintenance of the line, TWE has committed to maintain the approved access roads in a safe, useable condition, as directed by an authorized officer from the appropriate land management agency or private landowner.

S-11*: Permanent erosion control measures will be installed on all project access roads used for operations and maintenance. Erosion control measures will be inspected and maintained bi-annually.*

Effectiveness: The construction of permanent erosion control on all project access roads required for operations and maintenance would reduce the potential for off-site impacts associated with erosion and sedimentation to nearby waterways. In addition, it would help to prevent road washout, rilling, and down-cutting. If permanent erosion controls are installed and maintained on permanent access roads it would reduce the potential for degradation of native surface roads and sedimentation issues off-site.

Any surface disturbing activities along the ROW for operations or maintenance, would result in the reduction of protective soil cover such as vegetation, duff, and litter due to trampling or removal. Travel along the ROW would cause soil compaction, which would result in a corresponding loss of infiltration, permeability, and soil aeration. Runoff and soil erosion would increase as a result of compaction and a reduction in soil cover. Potential soil productivity impacts would result during maintenance operations along the ROW or at aboveground facilities from wind and water erosion of topsoil or soil mixing. These activities would occur intermittently and impacts would be localized to areas where maintenance occurs.

Where new access roads are built and maintained for operations there is some potential for indirect impacts to soil resources by trespass of the public onto the access roads. Access roads could provide access to the 2-mile transmission line corridor and to previously inaccessible areas along the length of the road. This is particularly evident where the natural vegetation levels are low and large open areas occur. Evidence of unauthorized cross country travel remains long after it occurs and subsequent users would follow the tracks increasing the potential for loss of vegetation, soil compaction and erosion in areas where no roads previously existed.

Soil contamination could occur during maintenance activities due to fuel or lubricant spills. If spills occur along the ROW they would result in localized impacts and could result in removal of contaminated soils.

BMPs and design features that would reduce impacts to soil resources during operation include the following:

- PHS-11 would require secondary containment for all on-site hazardous materials and waste storage areas.
- PHS-12 would ensure that wastes are properly containerized and removed periodically for disposal at appropriate off-site permitted disposal facilities.
- PHS-13 would require the applicant to initiate spill cleanup procedures and document the event, including a cause analysis; appropriate corrective actions taken; and a characterization of the resulting environmental or health and safety impacts. Documentation of the event should be provided to the land management agency's authorized officer and other federal and state agencies, as required.
- TWE-57: A Spill Prevention Notification and Clean-up Plan would be developed. The Plan would address compliance with all applicable federal, state, and local regulations, and would include: spill prevention measures, notification procedures in the event of a spill, employee awareness training, and commitment of manpower, equipment, and materials to respond to spills, if they occur.
- TWE-58: A Pesticide Use Plan would be developed. The Plan would address compliance with all applicable federal, state and local regulations.
- TWE-59: A Clean-up Work Management Plan would be developed. The plan would address on-site excavation of contaminated soils and debris and would include: identification of contaminants, methods of excavation, personnel training, safety and health procedures, sampling requirements, management of excavated soils and debris, and disposal methods.
- TWE-61: A Hazardous Materials Management Plan would be developed. Hazardous materials would not be drained onto the ground or drainage areas. Totally enclosed containment would be provided for all trash. All construction waste including trash and litter, garbage, other solid waste, petroleum products, and other potentially hazardous materials would be removed to a disposal facility authorized to accept such materials.
- TWE-62: If a reportable release of hazardous substance occurs at the work site, the Contractor would immediately notify the Applicant and all environmental agencies, as required by law. The Contractor would be responsible for the clean-up.

The application of design features and BMPs would help to reduce the risk of an accidental spill or release of hazardous materials. The BMPs and design features may not fully prevent soil contamination, but they would reduce the potential for soil contamination and help to meet state and federal requirements.

<u>Decommission Impacts</u>

Impacts during decommissioning would be similar to the impacts described for the construction phase of the project. During decommissioning, conductors, insulators, and hardware would be dismantled and removed from the ROW. Structures would be removed and foundations removed to below-ground surface. The 250-foot-wide transmission line ROW would have similar impacts to what is described for the construction phase of the project. TWE proposes to abandon foundations in place or just below the ground surface. This would result in permanent site specific impacts to soils. BMP GEN-16 would require all foundations to be removed to a minimum depth of 3 feet. Any concrete foundation left below the subsurface of the soil would create an artificial impervious layer that would change the hydrologic function of the soil. Additionally, it creates an artificial plane of weakness above the foundation creating potential for mass wasting. If terminals, substations, or regeneration stations are no longer required, the buildings, structures, and equipment would be dismantled and removed from the site. Foundations would be either abandoned in-place or cut off below ground level and buried. If foundations are abandoned in place there would be a permanent loss of soil resources at these locations. The ground electrode site at Morman Mesa is situated on old soils that contain thick petrocalcic horizons. These soils may pose reclamation challenges during decommissioning due to high carbonates and shallow to moderately deep eolian soils.

***S-12**: All concrete foundations will be removed during decommissioning, unless they are permanently anchored into stable bedrock.*

Effectiveness: Removal of the concrete foundations would reduce the potential for mass wasting and erosion of the soil above the concrete foundation. It also would allow for natural root growth of vegetation. If the concrete foundation is completely removed it would help to restore the hydrologic function of the soil back to its original state. This would increase the potential for reclamation success.

Decommissioning and reclamation of access roads following abandonment would be completed in accordance with the landowner's or land agency's direction.

***S-13**: Follow-up seeding using native seed or corrective erosion control measures are required on areas of surface disturbance that experience reclamation failure.*

Effectiveness: In locations where reclamation is unsuccessful, follow-up revegetation efforts would help to restore soil productivity and prevent the loss of topsoil.

BMPs and design features that would reduce impacts to soil resources during decommissioning include the following:

- BMP REST-1: topsoil removed during decommissioning activities shall be salvaged and reapplied during final reclamation; all areas of disturbed soil shall be reclaimed using weed-free native shrubs, grasses, and forbs or other plant species approved by the land management agency; grades would be returned to pre-development contours to the greatest extent feasible.
- BMP MIT-3: the decommissioning plan would include a site reclamation plan and a monitoring program.
- BMP GEN-14: Gravel work pads would be removed and disposed.
- GEN-16: equipment, components, and aboveground structures must be cleaned and removed from the site for reclamation, salvage, or disposal; all below-ground components would be removed to a minimum depth of 3 feet to establish a root zone free of obstacles.
- TWE-3: the COM Plan will include a mitigation monitoring plan that will address how each mitigation measure required by permitting agencies in their respective decision documents and permits will be monitored for compliance.

Measures **S-1**, **S-2**, **S-3**, **S-4**, **S-6**, **S-8**, **S-9**, and **S-12** as described in Sections 3.3.6.1 and 3.3.6.2 would be recommended to mitigate impacts associated with decommissioning. The application of BMPs, design features, and additional mitigation would reduce impacts to soil resources.

3.3.6.3 Region I

Region I would have impacts similar to what is described in Section 3.3.6.2, Impacts Common to all Alternative Routes and Associated Components. **Table 3.3-4** provides a summary of the data sources used for analysis in Region I. As stated in Section 3.3.2, detailed order 3 SSURGO soil survey data were utilized where available; all other areas were characterized using U.S. General Soil Map data. **Table 3.3-5** provides a comparison of impacts associated with the construction and operation of alternative routes in Region I. **Table 3.3-6** provides details of water erosion-prone soils impacted by construction and operation by watershed (HUC10; NRCS et al. 2010).

Table 3.3-4 Region I Data Sources Used for Analysis

Alternatives	Miles		Total Miles[1]	Percentage	
	SSURGO	GSM		SSURGO	GSM
Alternative I-A	111	44	155	71	29
Alternative I-B	104	55	159	66	34
Alternative I-C	162	24	186	87	13
Alternative I-D	123	49	171	72	28
Connectors					
Mexican Flats	8	2	10	83	17
Baggs	6	17	22	26	74
Fivemile Point North Alternative Connector	3	0	3	100	0
Fivemile Point South Alternative Connector	2	0	2	100	0

[1]Discrepancies in totals due to rounding error.

Table 3.3-5 Summary of Impacts to Soils by Alternatives in Region I

Parameter	Alternative I-A		Alternative I-B		Alternative I-C		Alternative I-D	
	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)
Water Erosion-Prone	259	69	271	68	301	75	269	65
Wind Erosion-Prone	231	60	239	57	270	72	238	56
Compaction-Prone	579	150	525	133	947	237	706	169
LRP[1]	741	187	786	184	558	129	913	208
Hydric[2]	0	0	0	0	7	2	0	0
Prime Farmland	129	37	136	36	293	80	136	36
Shallow Bedrock[3]	274	70	211	49	288	63	348	79
Risk of Corrosion (Concrete)	330	86	358	88	256	64	359	89
Risk of Corrosion (Steel)	1,113	287	1,108	266	1,243	309	1,089	256
Shallow Excavation Limitations	570	155	612	150	819	214	497	127
Small Commercial Building Limitations	762	207	731	184	1,178	310	681	173
Expansive Soils	213	57	187	49	350	91	283	69

[1] Limited Revegetation Potential.

[2] Wet Soils.

[3] Lithic Bedrock 60 inches or less from the soil surface.

Source: NRCS 2011.

Note: GSM data did not have interpretations for hydric soils, shallow excavations, small commercial buildings, or prime farmland. Percentages for these interpretations exclude areas with only GSM data.

Table 3.3-6 Project Impacts to Water Erosion-Prone Soils by Watershed in Region I

General Region I		I-A		I-B		I-C		I-D		Tuttle Easement Micro-siting Option 1		Tuttle Easement Micro-siting Option 1 - Comparison		Tuttle Easement Micro-siting Option 2		Tuttle Easement Micro-siting Option 2 - Comparison		Tuttle Easement Micro-siting Option 3		Tuttle Easement Micro-siting Option 3 - Comparison		Mexican Flats Alternative Connector		Baggs Alternative Connector		Fivemile Point North Alternative Connector		Fivemile Point South Alternative Connector	
HUC10	Watershed	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)
1405000505	Crooked Wash-White River	1	0	1	0	1	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0								
1405000204	Deception Creek-Yampa River					23	6																						
1405000111	Dry Creek-Yampa River					26	7																						
1405000106	Elkhead Creek					13	3																						
1405000107	Fortification Creek					61	15																						
1405000305	Fourmile Creek					46	11																						
1404020004	Frewen Lake	1	0	0	0	10	2	1	0																				
1405000309	Greasewood Gulch-Little Snake River	73	21	78	20			78	20	79	22	74	18	80	22	74	18	80	22	74	18								
1405000206	Hells Canyon-Yampa River	4	1	4	1	4	1	4	1	4	1	4	1	4	1	4	1	4	1	4	1								
1018000210	Iron Springs Draw-North Platte River	0	0	0	0	0	0	0	0																				
1405000308	Little Snake River-Powder Wash	37	10	35	9			40	10	1	0	1	0	1	0	1	0	1	0	1	0			25	5				
1405000302	Little Snake River-Willow Creek					16	4	0	0															27	7			1	0
1405000403	Lower Muddy Creek					18	4	6	1															9	2	14	1		
1405000307	Lower Sand Creek	18	5	23	5			36	6															18	5				
1405000202	Morgan Gulch-Yampa River					36	9																						
1405000311	Outlet Little Snake River	0	0																										
1405000402	Red Wash	13	3	15	3	1	0	1	0													4	1						
1405000310	Sand Wash	2	1																										
1405000205	Spring Creek-Yampa River	16	4	13	4	25	7	13	4	18	4	13	4	10	3	13	4	11	3	13	4								
1018000213	Sugar Creek	48	11	48	11	48	11	48	11																				

Table 3.3-6 Project Impacts to Water Erosion-Prone Soils by Watershed in Region I

General Region I		I-A		I-B		I-C		I-D		Tuttle Easement Micro-siting Option 1		Tuttle Easement Micro-siting Option 1 - Comparison		Tuttle Easement Micro-siting Option 2		Tuttle Easement Micro-siting Option 2 - Comparison		Tuttle Easement Micro-siting Option 3		Tuttle Easement Micro-siting Option 3 - Comparison		Mexican Flats Alternative Connector		Baggs Alternative Connector		Fivemile Point North Alternative Connector		Fivemile Point South Alternative Connector	
HUC10	Watershed	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)
1405000401	Upper Muddy Creek					1	0	0	0													0	0						
1405000306	Upper Sand Creek			6	1																								
1404020013	Upper Separation Creek	47	12	47	12	58	14	47	12																				
1405000701	Wolf Creek	60	16	60	16	60	16	60	16	53	13	60	16	53	13	60	16	53	13	60	16								

Notes: Discrepancies in totals may occur due to rounding.
Blanks denote no impacts.

Source: NRCS 2011; NRCS et al. 2010.

Alternative I-A (Applicant Proposed)

Key Parameters Summary

Detailed SSURGO data were analyzed on approximately 71 percent of Alternative I-A. The remaining 29 percent was analyzed using U.S. GSM data. The primary constraints for Alternative I-A during construction would be disturbance of 741 acres of soils with limited revegetation potential and 579 acres of compaction prone soils. Mitigation measures **S-1**, **S-2**, **S-3**, **S-5**, **S-9**, and **S-13** would help to reduce impacts on these soils and increase the potential for revegetation. Soils with limitations associated with the risk of corrosion to steel are prevalent along this route (1,113 acres); however the effects of corrosion on steel structures would be offset by the use of protective coating and cathodic protection. No substantive effect is expected related to corrosion.

Alternative I-B

Key Parameters Summary

Detailed SSURGO data were analyzed on approximately 66 percent of Alternative I-B. The remaining 34 percent was analyzed using U.S. GSM data. The primary constraints for Alternative I-B during construction would be disturbance of 786 acres of soils with limited revegetation potential and 525 acres of compaction prone soils. Mitigation measures **S-1**, **S-2**, **S-3**, **S-5**, **S-9**, and **S-13** would help to reduce impacts on these soils and increase the potential for revegetation. Soils with limitations associated with the risk of corrosion to steel are prevalent along this route (1,108 acres); however the effects of corrosion on steel structures would be offset by the use of protective coating and cathodic protection. No substantive effect is expected related to corrosion.

Alternative I-C

Key Parameters Summary

Detailed SSURGO data were analyzed on approximately 87 percent of Alternative I-C. The remaining 13 percent was analyzed using U.S. GSM data. The primary constraints for Alternative I-C during construction would be disturbance of 558 acres of soils with limited revegetation potential and 947 acres of compaction prone soils. Mitigation measures **S-1**, **S-2**, **S-3**, **S-5**, **S-9**, and **S-13** would help to reduce impacts on these soils and increase the potential for revegetation. Soils with limitations associated with the risk of corrosion to steel are prevalent along this route (1,243 acres); however the effects of corrosion on steel structures would be offset by the use of protective coating and cathodic protection. No substantive effect is expected related to corrosion.

Alternative I-D (Agency Preferred)

Key Parameters Summary

Detailed SSURGO data were analyzed on approximately 72 percent of Alternative I-D. The remaining 28 percent was analyzed using U.S. GSM data. The primary constraints for Alternative I-D during construction would be disturbance of 913 acres of soils with limited revegetation potential and 706 acres of compaction prone soils. Mitigation measures **S-1**, **S-2**, **S-3**, **S-5**, **S-9**, and **S-13** would help to reduce impacts on these soils and increase the potential for revegetation. Soils with limitations associated with the risk of corrosion to steel are prevalent along this route (1,089 acres); however the effects of corrosion on steel structures would be offset by the use of protective coating and cathodic protection. No substantive effect is expected related to corrosion.

The Tuttle Easement micro-siting options 1, 2, and 3 would result in similar impacts to soil resources. In general, soil limitations along the micro-siting options 1, 2, and 3 are similar to Alternative I-D. However, micro-siting options 2 and 3 would impact more prime farmland soils than Alternative I-D.

Alternative Connectors in Region I

Table 3.3-7 summarizes the characteristics of soils that would be impacted by the various connectors and advantages associated with the alternative connectors in Region I.

Table 3.3-7 Summary of Region I Alternative Connector Impacts for Soils

Alternative Connector	Analysis	Advantage
Mexican Flats Alternative Connector	Approximately 2 acres of water erodible, 17 acres of wind erodible, 72 acres of LRP, 48 acres of compaction prone, and 52 acres of shallow soils would be impacted during construction if this alternative connector were used.	Less LRP, compaction prone, and erodible soils are located on the Alternative C route compared to the Alternative A or B route. Less compaction prone soils are located on Alternative A than on Alternative B. The connecter would help reduce impacts to the soils on Alterative A or B if the alternate connector was utilized. However, the acreage of soils disturbed would increase if the connector were used to cross over to the Alternative C route.
Baggs Alternative Connector	Approximately 64 acres of water erodible, 1 acres of wind erodible, 38 acres of soils with shallow bedrock, 167 acres of LRP, and 126 acres of compaction prone soils would be impacted during construction if this alternative connector were used.	This connector route would reduce the overall acres of soil resources impacted by Alternative C. This would be a benefit to soil resources.
Fivemile Point North Alternative Connector	Approximately 50 acres of LRP, 26 acres of compaction prone, and 26 acres of shallow soils would be impacted during construction if this alternative connector were used. No water or wind erosion-prone soils would be impacted.	This connector route would reduce the overall acres of soil resources impacted by Alternative C. This would be a benefit to soil resources.
Fivemile Point South Alternative Connector	Approximately 19 acres of LRP, 10 acres of compaction prone, and 5 acres of shallow soils would be impacted during construction if this alternative connector were used. No water or wind erosion-prone soils would be impacted.	This connector route would reduce the acres of soil resources impacted by Alternative C. This would be a benefit to soil resources.

Alternative Ground Electrode System Locations in Region I

Table 3.3-8 summarizes disturbance impacts associated with ground electrode systems in Region I.

Table 3.3-8 Summary of Region I Alternative Ground Electrode System Impacts (Acres)[1]

	Wind Erodible	Water Erodible	Compaction Prone	LRP	Hydric	Prime Farmland	Shallow Bedrock	Risk of Corrosion - Concrete	Risk of Corrosion - Steel	Shallow Excavations	Expansive Soils
Little Snake East (Alternatives I-A, I-B, and I-D)	207	19	67	19	0	0	72	19	250	506	0
Little Snake West (Alternative I-A)	90	0	299	253	0	0	0	274	494	213	21
Little Snake West (Alternatives I-B and I-D)	90	0	299	253	0	0	0	274	494	213	0

Table 3.3-8 Summary of Region I Alternative Ground Electrode System Impacts (Acres)[1]

	Wind Erodible	Water Erodible	Compaction Prone	LRP	Hydric	Prime Farmland	Shallow Bedrock	Risk of Corrosion - Concrete	Risk of Corrosion - Steel	Shallow Excavations	Expansive Soils
Separation Creek	0	39	112	320	0	0	127	233	339	0	16
Separation Flat (All Alternative Routes)	150	0	0	360	0	0	0	0	600	0	0
Shell Creek (Alternative I-B)	138	42	162	462	0	0	0	42	582	0	90
Eight Mile Basin	0	221	305	443	0	0	83	0	526	0	55

[1] Limited Revegetation Potential

[2] Wet Soils

[3] Lithic Bedrock 60 inches or less from the soil surface.

Note: Acreages are based on 600-acre siting areas, but much smaller areas within the siting areas would be required for the facilities as shown in Chapter 2.0, **Table 2-8**.

Region I Conclusion

As presented in **Table 3.3-5**, Alternative I-C would have the greatest impacts on soil resources. Alternative I-C would impact more compaction prone soils, hydric soils, prime farmland, soils prone to shrink-swell, wind and water erodible soils, soils with severe limitations associated with shallow excavations, and soils that are corrosive to steel than the other alternatives. Alternative I-D would impact more LRP, soils with shallow bedrock, and soils corrosive to concrete. In general, Alternative I-A and I-B would have the least overall impact on soil resources.

3.3.6.4 Region II

Region II would have impacts similar to those discussed in Section 3.3.6.2, Impacts Common to all Alternative Routes and Associated Components.

Soils within the San Rafael Swell and throughout the Green River and Grand Valley areas weathered from sedimentary materials (primarily shale, sandstone, and limestone deposits) containing large amounts of selenium, calcium carbonate, and soluble salts. These soils are susceptible to the development of large sinkholes, piping, and subsidence. In addition, these soils have limited revegetation potentials, are corrosive to both cement and steel structures, are highly susceptible to wind and water erosion, and surface puddling. Stabilization and revegetation of these soils following surface disturbance would be difficult.

Alternatives II-A, II-B, II-C, II-D, II-E, and II-F each cross areas of fine textured soils derived from the North Horn Formation. These soils weathered from calcareous claystone, siltstone, mudstone, deposits. During periods of high moisture, soils on steep slopes (**Figure 3.2-8**) become unstable resulting in soil creep, slumping, or large landslides. These soils create hazards for transmission line structures and associated facilities. In addition, where construction modifies the slope face (cut and fill) the incidence for slope failure increases. Landslide susceptibility and incidence in Region II is illustrated on **Figure 3.2-8**. Roads, structures, and facilities would risk damage and loss of service due to unstable soils hazards in Region II. Hazards associated with unstable soils and bedrock are discussed further in Section 3.2.6, Impacts to Geological, Mineral, and Paleontological Resources.

Alternatives II-A, II-D, and II-E each cross areas of sand dunes along segments 360 and 430. Dune lands consist of sand in ridges and intervening troughs that constantly shift with the wind. These soils are highly wind erodible. Blowouts may also be common in these areas and consist of areas from which all or most of the soil material has been removed by extreme wind erosion. Siting towers in these areas could result in towers being buried by dunes or blowouts at the tower site. Biological soil crusts are highly susceptible to disturbance, especially in sandy soils (Belnap and Gardner 1993). Recovery rates are generally slow, specifically for lichen and moss recovery, which can take 45 to 250 years respectively (Belnap and Gillette 1997). Losses of biological soils crusts would be expected where surface disturbance occurs. Surface roughness or crusts (biological or physical) would be damaged by construction activities (i.e., clearing, grubbing, excavation, vehicle traffic) and are likely to be susceptible to wind or water erosion even if they are not rated erosion prone. Disturbed soils that are not successfully reclaimed or stabilized are likely to lose productivity and the ability to sustain vegetation over the long term, which would reduce watershed health and contribute to sedimentation in surface water or degradation of local air quality. It is not possible to quantify or locate all of the areas where this may occur. Losses in soil productivity due to wind erosion are most likely to occur on soils that are saline or alkaline, fine-textured, and formed in some lake sediments.

BMPs that would reduce impacts to soil resources include the following: BMP PHS-6 (applicants would develop a comprehensive emergency plan that considers the vulnerabilities of their energy system to all credible events initiated by natural causes…); and BMP PHS-4 (health and safety program shall establish a safety zone or setback from roads and other public access areas that is sufficient to prevent accidents resulting from various hazards).

***S-14**: TWE would avoid constructing in areas of unstable soils prone to slumping or mass wasting. Prior to construction, a hazard plan would be developed by TWE depicting the landslide-prone avoidance areas. This plan would be included in the POD submitted to the agencies for approval prior to the Notice to Proceed.*

Effectiveness: Avoidance of unstable slopes is the best way to prevent impacts to the transmission line and facilities associated with landslides, slumping, and soil creep. Avoidance of landslide prone soils would reduce but may not fully mitigate impacts associated with soils prone to slumping or soil creep. Catastrophic events may not always be predictable, but avoidance of known unstable areas would help to reduce impacts.

Table 3.3-9 provides a summary of the data sources used for analysis in Region II. As stated in Section 3.3.2, detailed order 3 SSURGO soil survey data were utilized where available; all other areas were characterized using U.S. GSM data. **Table 3.3-10** provides a comparison of impacts associated with the construction and operation of alternative routes in Region II. **Table 3.3-11** provides details of water erosion-prone soils impacted by construction and operation by watershed (HUC 10; NRCS et al. 2010).

Table 3.3-9 Region II Data Sources Used for Analysis

Alternatives	Miles		Total Miles[1]	Percentage	
	SSURGO	GSM		SSURGO	GSM
Alternative II-A	168	89	257	65	35
Alternative II-B	305	40	345	88	12
Alternative II-C	316	48	364	87	13
Alternative II-D	214	48	262	82	18
Alternative II-E	167	100	266	63	37

Table 3.3-9 Region II Data Sources Used for Analysis

Alternatives	Miles		Total Miles[1]	Percentage	
	SSURGO	GSM		SSURGO	GSM
Alternative II-F	173	94	267	65	35
Connectors					
Castle Dale Alternative Connector	11	0	11	100	0
Price Alternative Connector	18	0	18	100	0
Lynndyl	24	0	24	100	0
IPP East	3	0	3	100	0
Connector					
Highway 191	0	5	5	0	100
Variation					
Emma Park	15	20	35	42	58
Alternative II-F Comparable	0	32	32	0	100
Variations					
Strawberry A	0	74	74	0	100
Strawberry A comparable	0	74	74	0	100
Strawberry B	0	74	74	0	100
Strawberry B comparable	0	74	74	0	100
Strawberry C	0	74	74	0	100
Strawberry C comparable	0	74	74	0	100
Cedar Knoll A	23	5	28	81	19
Cedar Knoll A comparable	21	7	28	77	23
Cedar Knoll B	24	5	29	84	16
Cedar Knoll B comparable	21	7	28	76	23

[1] Discrepancies in totals due to rounding.

Table 3.3-10 Summary of Impacts to Soils by Alternatives in Region II

	Alternative II-A		Alternative II-B		Alternative II-C		Alternative II-D		Alternative II-E		Alternative II-F	
Parameter	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)
Water Erosion-Prone	194	73	580	159	612	160	252	75	246	75	257	79
Wind Erosion-Prone	247	58	152	38	167	38	280	68	247	57	210	53
Compaction-Prone	1,214	410	2,013	572	1,929	506	1,317	401	1,137	364	1,361	446
LRP[1]	1,092	325	1,921	494	2,351	605	1,081	291	1,045	278	1,247	356
Hydric[2]	50	13	73	19	74	17	26	7	36	9	51	12
Prime Farmland	347	95	413	117	484	120	279	90	278	85	178	62
Shallow Bedrock[3]	663	204	723	233	799	213	1,123	339	816	246	1,174	376
Risk of Corrosion (Concrete)	613	169	1,093	273	1,306	332	595	152	489	117	635	164
Risk of Corrosion (Steel)	2,347	723	3,263	914	3,283	836	2,460	722	2,352	694	2,473	776
Shallow Excavation Limitations	1,368	442	2,504	698	2,414	615	2,004	604	1,340	421	1,587	505
Small Commercial Building Limitations	1,559	499	2,878	796	2,856	731	2,206	660	1,493	465	1,775	556
Expansive Soils	592	208	706	202	600	152	489	148	526	176	609	205

[1] Limited Revegetation Potential

[2] Wet Soils

[3] Lithic Bedrock 60 inches or less from the soil surface

Source: NRCS 2011.

Note: GSM data did not have interpretations for hydric soils, shallow excavations, small commercial buildings, or prime farmland. Percentages for these interpretations exclude areas with only GSM data.

Table 3.3-11 Project Impacts to Water Erosion-Prone Soils by Watershed in Region II

General Region II		II-A		II-B		II-C		II-D		II-E		II-F		Emma Park Alternative Variation		Emma Park Alternative Variation - Comparison		Strawberry IRA Micro-siting Option 1		Strawberry IRA Micro-siting Option 1 - Comparison		Strawberry IRA Micro-siting Option 2		Strawberry IRA Micro-siting Option 2 - Comparison		Strawberry IRA Micro-siting Option 3		Strawberry IRA Micro-siting Option 3 - Comparison		Cedar Knoll IRA Micro-siting Option 1		Cedar Knoll IRA Micro-siting Option 1 - Comparison		Cedar Knoll IRA Micro-siting Option 2		Cedar Knoll IRA Micro-siting Option 2 - Comparison		Highway 191 Alternative Connector		Castle Dale Alternative Connector		Price Alternative Connector		Lynndyl Alternative Connector		IPP East Alternative Connector	
HUC10	Watershed	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)
1406000604	Agency Draw-Willow Creek							17	5			17	5																																		
1406000305	Antelope Creek							5	1	16	4	5	1																																		
1406000402	Avintaquin Creek											5	2			5	2																														
1406000705	Beaver Creek-Price River							13	5	44	11	13	5	24	9	13	5																														
1403000101	Bitter Creek			50	12	50	12																																								
1405000709	Bitter Creek			0	0	0	0																																								
1603000514	Chalk Creek					11	3																																								
1403000106	Cisco Wash			15	4	15	4																																								
1406000102	Cliff Creek	39	13					21	6	21	6	21	6																																		
1406000708	Coal Creek-Price River			10	2			0	0					0	0																											1	0				
1403000104	Cottonwood Canyon			13	3	13	3																																								
1406000902	Cottonwood Creek			66	26	51	14																																	2	1						
1406000310	Cottonwood Creek-Dry Gulch Creek	4	1							4	1																																				
1406000710	Cottonwood Wash-Price River			0	0																																										
1405000711	Cottonwood Wash-White River							12	3	10	3	12	3																																		
1405000710	Coyote Wash							97	23	57	13	97	23																																		
1406000404	Currant Creek	8	3															8	3	8	3	8	3	8	3	8	3	8	3																		
1406000707	Desert Seep Wash			70	14																																					8	2				
1602020203	Diamond Fork	0	0															0	0	0	0	0	0	0	0	0	0	0	0																		
1405000705	Dripping Rock Creek-White River	14	3					14	3	14	3	14	3																																		
1406000309	Dry Gulch Creek	0	0							0	0							0	0	0	0	0	0	0	0	0	0	0	0																		
1406000315	Duchesne River									1	0																																				
1405000706	Evacuation Creek			1	0	1	0																																								
1406000903	Ferron Creek					56	16																																								

Table 3.3-11 Project Impacts to Water Erosion-Prone Soils by Watershed in Region II

General Region II		II-A		II-B		II-C		II-D		II-E		II-F		Emma Park Alternative Variation		Emma Park Alternative Variation - Comparison		Strawberry IRA Micro-siting Option 1		Strawberry IRA Micro-siting Option 1 - Comparison		Strawberry IRA Micro-siting Option 2		Strawberry IRA Micro-siting Option 2 - Comparison		Strawberry IRA Micro-siting Option 3		Strawberry IRA Micro-siting Option 3 - Comparison		Cedar Knoll IRA Micro-siting Option 1		Cedar Knoll IRA Micro-siting Option 1 - Comparison		Cedar Knoll IRA Micro-siting Option 2		Cedar Knoll IRA Micro-siting Option 2 - Comparison		Highway 191 Alternative Connector		Castle Dale Alternative Connector		Price Alternative Connector		Lynndyl Alternative Connector		IPP East Alternative Connector	
HUC10	Watershed	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)
1406000704	Gordon Creek							3	1																																	12	4				
1406000709	Grassy Trail Creek			15	3																																										
1407000202	Headwaters Muddy Creek					16	5																																								
1406000901	Huntington Creek			44	16	35	7	14	5																															71	19						
1406000407	Indian Canyon									0	0	0	0			0	0																														
1407000201	Ivie Creek					61	17																																								
1603000501	Ivie Creek					5	1																																					0	0		
1406000803	Little Grand Wash			42	12	42	12																																								
1406000711	Little Park Wash-Price River			45	9	35	7																																								
1603000305	Lost Creek-Sevier River					33	9																																								
1406000801	Lost Spring Wash-Saleratus Wash			6	2	42	9																																								
1406000504	Lower Ninemile Creek							5	3			5	3																																		
1406000408	Lower Strawberry River	12	4															12	4	12	4	12	4	12	4	12	4	12	4																		
1401000519	McDonald Creek-Colorado River			10	3	10	3																																								
1603000512	Middle Sevier River			12	4	0	0					12	4																																		
1406000403	Middle Strawberry River	35	12															37	12	35	12	38	13	35	12	38	13	35	12																		
1406000706	Miller Creek																																									0	0				
1406000904	North Salt Wash					35	10																																								
1406000106	Pelican Lake-Green River	10	2							10	2																																				
1406000308	Pigeon Water Creek-Lake Fork River	18	7							5	1							18	7	18	7	18	7	18	7	18	7	18	7																		
1406000406	Rabbit Gulch	25	9															26	9	25	9	26	9	25	9	25	9	25	9																		
1406000405	Red Creek	25	8															25	8	25	8	25	8	25	8	25	8	25	8																		
1405000704	Red Wash-White River	23	6	1	0	1	0	23	6	23	6	23	6																																		

Table 3.3-11 Project Impacts to Water Erosion-Prone Soils by Watershed in Region II

General Region II		II-A		II-B		II-C		II-D		II-E		II-F		Emma Park Alternative Variation		Emma Park Alternative Variation - Comparison		Strawberry IRA Micro-siting Option 1		Strawberry IRA Micro-siting Option 1 - Comparison		Strawberry IRA Micro-siting Option 2		Strawberry IRA Micro-siting Option 2 - Comparison		Strawberry IRA Micro-siting Option 3		Strawberry IRA Micro-siting Option 3 - Comparison		Cedar Knoll IRA Micro-siting Option 1		Cedar Knoll IRA Micro-siting Option 1 - Comparison		Cedar Knoll IRA Micro-siting Option 2		Cedar Knoll IRA Micro-siting Option 2 - Comparison		Highway 191 Alternative Connector		Castle Dale Alternative Connector		Price Alternative Connector		Lynndyl Alternative Connector		IPP East Alternative Connector	
HUC10	Watershed	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)
1403000107	Sagers Wash			71	18	71	18																																								
1603000304	Salina Creek					102	29																																								
1403000501	Salt Wash			8	2	8	2																																								
1406000804	Salt Wash-Green River			30	8	30	8																																								
1406000702	Scofield Reservoir							28	10	2	1																																				
1406000505	Sheep Wash-Green River							20	5			20	5																																		
1603000401	Silver Creek	0	0	4	1			40	13	0	0	0	0																																		
1602020201	Soldier Creek	48	20							65	28	65	28					6	2	7	2	6	2	7	2	6	2	7	2	41	18	41	18	41	18	41	18										
1406000304	Strawberry River-Duchesne River	20	7							28	7							20	7	20	7	20	7	20	7	20	7	20	7																		
1406000805	Tenmile Canyon			11	3	11	3																																								
1602020202	Thistle Creek	72	35					1	1	72	35	72	35																	63	33	72	35	60	33	72	35										
1406000802	Tusher Wash-Green River			1	0	1	0																																								
1406000314	Uinta River	0	0							0	0																																				
1406000503	Upper Ninemile Creek							63	18	21	5	96	30	8	3	40	15																														
1406000501	Upper Pariette Draw							0	0			0	0																																		
1603000402	Upper San Pitch River			62	24			73	29																																						
1406000905	Upper San Rafael River					37	8																																								
1603000504	Upper Sevier River			0	0							0	0																															1	0		
1406000401	Upper Strawberry River	14	4															12	3	14	4	11	3	14	4	11	3	14	4																		
1406000105	Walker Hollow-Green River	80	32					10	2	36	10	10	2																																		
1602020101	West Creek	30	14	0	0			16	9	30	14	30	14																	16	7	17	7	16	7	17	7										
1401000517	West Salt Creek			80	22	80	22																																								
1403000102	Westwater Creek			38	10	38	10																																								
1403000108	Westwater Creek-Colorado River			33	9	33	9																																								

Table 3.3-11 Project Impacts to Water Erosion-Prone Soils by Watershed in Region II

General Region II		II-A		II-B		II-C		II-D		II-E		II-F		Emma Park Alternative Variation		Emma Park Alternative Variation - Comparison		Strawberry IRA Micro-siting Option 1		Strawberry IRA Micro-siting Option 1 - Comparison		Strawberry IRA Micro-siting Option 2		Strawberry IRA Micro-siting Option 2 - Comparison		Strawberry IRA Micro-siting Option 3		Strawberry IRA Micro-siting Option 3 - Comparison		Cedar Knoll IRA Micro-siting Option 1		Cedar Knoll IRA Micro-siting Option 1 - Comparison		Cedar Knoll IRA Micro-siting Option 2		Cedar Knoll IRA Micro-siting Option 2 - Comparison		Highway 191 Alternative Connector		Castle Dale Alternative Connector		Price Alternative Connector		Lynndyl Alternative Connector		IPP East Alternative Connector	
HUC10	Watershed	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)
1406000701	White River									38	10	25	6	22	7	15	4																																
1406000703	Willow Creek							17	7	11	3	26	10	13	5	26	10																					9	3										
1405000701	Wolf Creek	3	1	6	1	6	1	3	1	3	1	3	1																																				

[1] Discrepancies in totals due to rounding.

Note: Blanks denote no impacts.

Sources: NRCS 2011; NRCS et al. 2010.

Alternative II-A (Applicant Proposed)

Key Parameters Summary

Detailed SSURGO data were analyzed on approximately 65 percent of Alternative II-A. The remaining 35 percent was analyzed using U.S. GSM data. The primary constraints for Alternative II-A during construction would be disturbance of 1,092 acres of soils with limited revegetation potential and 1,214 acres of compaction prone soils. Mitigation measures **S-1**, **S-2**, **S-3**, **S-5**, **S-9**, **S-13**, and **VG-1** would help to reduce impacts on these soils and increase the potential for revegetation. Soils with limitations associated with the risk of corrosion to steel are prevalent along this route (2,347 acres); however, the effects of corrosion on steel structures would be offset by the use of protective coating and cathodic protection. No substantive effect is expected related to corrosion. Soil limitations within the analysis area related to shallow excavations include cutback caving, flooding, large stones, slope, and a cemented pan within the soil profile.

Along Alternative II-A are three micro-siting alternatives, Strawberry IRA Options 1, 2, and 3. For the Strawberry IRA micro-siting option, the soils located along Option 1, 2, and 3 have similar soil limitations to the soils located along Alternative II-A.

Alternative II-B

Key Parameters Summary

Detailed SSURGO data were analyzed on approximately 88 percent of Alternative II-B. The remaining 12 percent was analyzed using U.S. GSM data. The primary constraints for Alternative II-B during construction would be disturbance of 1,921 acres of soils with limited revegetation potential and 2,013 acres of compaction prone soils. Mitigation measures **S-1**, **S-2**, **S-3**, **S-5**, **S-9**, **S-13**, and **VG-1** would help to reduce impacts on these soils and increase the potential for revegetation. Soils with limitations associated with the risk of corrosion to steel are prevalent along this route (3,263 acres); however the effects of corrosion on steel structures would be offset by the use of protective coating and cathodic protection. No substantive effect is expected related to corrosion.

Alternative II-C

Key Parameters Summary

Detailed SSURGO data were analyzed on approximately 87 percent of Alternative II-C. The remaining 13 percent was analyzed using U.S. GSM data. The primary constraints for Alternative II-C during construction would be disturbance of 2,351 acres of soils with limited revegetation potential and 1,929 acres of compaction prone soils. Additionally Alternative II-C would cross Mancos shale outcrops near Rangely. Any soils derived from Mancos shale would be saline and difficult to reclaim. Mitigation measures **S-1**, **S-2**, **S-3**, **S-5**, **S-9**, **S-13**, and **VG-1** would help to reduce impacts on these soils and increase the potential for revegetation. Soils with limitations associated with the risk of corrosion to steel are prevalent along this route (3,283 acres); however the effects of corrosion on steel structures would be offset by the use of protective coating and cathodic protection. No substantive effect is expected related to corrosion.

Alternative II-D

Key Parameters Summary

Detailed SSURGO data were analyzed on approximately 82 percent of Alternative II-D. The remaining 18 percent was analyzed using U.S. GSM data. The primary constraints for Alternative II-D during construction would be disturbance of 1,081 acres of soils with limited revegetation potential and 1,317 acres of compaction prone soils. Mitigation measures **S-1**, **S-2**, **S-3**, **S-5**, **S-9**, **S-13**, and **VG-1** would help to reduce impacts on these soils and increase the potential for revegetation. Soils with limitations associated with the risk of corrosion to steel are prevalent along this route (2,460 acres); however the effects of corrosion on steel structures would be offset by the use of protective coating and cathodic protection. No substantive effect is expected related to corrosion. Soil limitations within the analysis area related to shallow excavations include cutback caving, flooding, large stones, slope, and a cemented pan within the soil profile.

Alternative II-E

Key Parameters Summary

Detailed SSURGO data were analyzed on approximately 63 percent of Alternative II-E. The remaining 37 percent was analyzed using U.S. GSM data. The primary constraints for Alternative II-E during construction would be disturbance of 1,045 acres of soils with limited revegetation potential and 1,137 acres of compaction prone soils. Mitigation measures **S-1**, **S-2**, **S-3**, **S-5**, **S-9**, **S-13**, and **VG-1** would help to reduce impacts on these soils and increase the potential for revegetation. Soils with limitations associated with the risk of corrosion to steel are prevalent along this route (2,352 acres); however the effects of corrosion on steel structures would be offset by the use of protective coating and cathodic protection. No substantive effect is expected related to corrosion. Soil limitations within the analysis area related to shallow excavations include cutback caving, flooding, large stones, slope, and a cemented pan within the soil profile.

Along Alternative II-E are two sets of microsite alternatives, Strawberry IRA Option 1, 2, and 3 and Cedar Knoll IRA Option 1, and 2. For the Strawberry IRA Option microsites, the soils located along Option 1, 2, and 3 have fewer soil limitations than the soils located along Alternative II-E. The Cedar Knoll IRA Option 1 and 2 also have fewer soil limitations than soils along Alternative II-E.

Alternative II-F (Agency Preferred)

Detailed SSURGO data were analyzed on approximately 65 percent of Alternative II-F. The remaining 35 percent was analyzed using U.S. GSM data. Alternative II-F would impact the highest acreage of soils with constraints and limitations. The primary constraints for Alternative II-F during construction would be disturbance of 1,247 acres of soils with limited revegetation potential and 1,361 acres of compaction prone soils. Mitigation measures **S-1**, **S-2**, **S-3**, **S-5**, **S-9**, **S-13**, and **VG-1** would help to reduce impacts on these soils and increase the potential for revegetation. Soils with limitations associated with the risk of corrosion to steel are prevalent along this route (2,473 acres); however the effects of corrosion on steel structures would be offset by the use of protective coating and cathodic protection. No substantive effect is expected related to corrosion. Soil limitations within the analysis area related to shallow excavations include cutback caving, flooding, large stones, slope, and a cemented pan within the soil profile.

Along Alternative II-F are micro-siting options, Cedar Knoll IRA options 1 and 2. The Cedar Knoll IRA options 1 and 2 have fewer soil limitations than soils along Alternative II-F.

Alternative Variation in Region II

Emma Park Alternative Variation

The Emma Park Alternative Variation would impact more water erodible, compaction prone, prime farmland, soils with shallow bedrock, and soils with severe limitations related to shallow excavations and small commercial buildings than Alternative II-F. The Emma Park Alternative Variation would impact fewer LRP soils and expansive soils.

Alternative Connectors in Region II

Table 3.3-12 summarizes the characteristics of soils that would be impacted by the various connectors and impacts and advantages associated with the alternative connectors in Region II.

Table 3.3-12 Summary of Region II Alternative Connector Impacts for Soils

Alternative Connector	Analysis	Advantage
Highway 191 Alternative Connector	Approximately 27 acres of LRP, 4 acres of expansive soils, 18 acres of compaction prone soils, 54 acres of soils shallow to bedrock, and 68 acres soils corrosive to steel, would be impacted during construction.	This connector would link Alternative II-F to the Alternative II-E route or to the Emma Park Alternative Variation. This would reduce impacts to soils with shallow bedrock and may help to reduce impacts to soils prone to slumping or landslides.
Castle Dale Alternative Connector	Approximately 59 acres water erodible soils, 144 acres of LRP, 31 acres of expansive soils, 114 acres of compaction prone soils, 140 acres soils corrosive to steel, and 14 acres of prime farmland would be impacted during construction.	This connector would link the Alternative II-C route to Alternatives II-A, II-B, or II-D, which would result in less acreage of surface disturbance to soils.
Price Alternative Connector	Approximately 4 acres of water erodible soils, 59 acres of LRP soils, 175 acres of soils corrosive to steel, 67 acres of prime farmland, and 44 acres of shallow soils would be impacted. No wind erodible soils would be impacted.	This connector would link the Alternative II-B route to Alternative II-D, which would result in less acreage of surface disturbance to soils.
Lynndyl Alternative Connector (Alternatives II-B and II-C)	Approximately 48 acres of prime farmland, 157 acres of soils with a shallow depth to bedrock, 38 acres of LRP, and 42 acres of compaction prone soils would be impacted if this alternative connector were used. No wind erodible or water erodible soils would be impacted	Less prime farmland, LRP, and wind erodible soils are located on the Alternative II-B route compared to the Alternative II-C route. The connecter would help reduce impacts to the soils on Alterative II-C if the alternate connector was utilized.
IPP East Alternative Connector (Alternatives II-A and II-B)	Approximately 28 acres of wind erodible soils, 30 acres of LRP, and 31 acres of soils corrosive to steel and 30 acres of soils corrosive to concrete would be impacted. No water erodible soils, shallow soils, or prime farmland would be impacted.	Less hydric and LRP soils occur on the Alternative II-B route compared to the Alternative II-A route. The connecter would allow for avoidance of sensitive soils associated with Alternative II-A.

Region II Conclusion

As presented in **Table 3.3-10**, Alternative II-C would have the greatest impact on soil resources. Alternative II-C would impact more water erodible soils, LRP soils, hydric soils, prime farmland soils, and soils corrosive to concrete and steel than the other alternatives. Alternative II-B would impact more compaction prone soils, soils prone to shrink-swell, and soils with severe limitations for shallow excavations than the other alternatives. In general, Alternative II-A and II-E would have the least overall impact on soil resources.

3.3.6.5 Region III

Region III would have impacts similar to those discussed in Section 3.3.6.2, Impacts Common to all Alternative Routes and Associated Components.

Portions of Region III are comprised soils derived from the Green River Formation (lake sediments with interbedded limestone, sandstone, mudstone, saline evaporate deposits, siltstone and dolomite). These soils have a carbonaceous mineralogy (> 40 percent $CaCO_3$ in the subsoil horizons and substratum layers) and are strongly alkaline. These soils would have limited revegetation potentials, especially on south and west aspects and may require seed mixes that include species adapted to the chemical characteristics of the soils.

Alternative III-A crosses an inventoried roadless area on the Dixie NF. IRAs may contain important environmental values that warrant protection and are, as a general rule, managed to preserve their roadless characteristics. The 250-foot-wide transmission line ROW would create a linear disturbance in an otherwise undisturbed landscape, which could create access routes for trespass. Indirect effects that could occur due to trespass include soil compaction and increased erosion.

As stated in Section 3.3.6.4, losses of biological soils crusts would be expected where surface disturbance occurs. Similar impacts to soils would be expected in Region III from loss of surface crusts.

Region III would have impacts similar to those discussed in Section 3.3.6.2, Impacts Common to all Alternative Routes and Associated Components. In locations where operations or maintenance activities disturb or remove the protective soil cover (vegetation and vegetative litter) on droughty, saline, or strongly alkaline soils, these soils would be highly erodible and difficult to revegetate.

Table 3.3-13 provides a summary of the data sources used for analysis in Region III. As stated in Section 3.3.2, detailed order 3 SSURGO soil survey data were utilized where available; all other areas were characterized using U.S. **Table 3.3-14** provides a comparison of impacts associated with the construction and operation of alternative routes in Region III. **Table 3.3-15** provides details of water erosion-prone soils impacted by construction and operation by watershed (HUC10; NRCS et al. 2010).

Table 3.3-13 Region III Data Sources Used for Analysis

	Miles			Percentage	
Alternatives	**SSURGO**	**GSM**	**Total Miles[1]**	**SSURGO**	**GSM**
Alternative III-A	195	81	276	71	29
Alternative III-B	222	63	285	78	22
Alternative III-C	258	50	308	84	16
Connectors					
Avon	8	0	8	100	0
Moapa	13	0	13	100	0

Table 3.3-13 Region III Data Sources Used for Analysis

Alternatives	Miles			Percentage	
	SSURGO	GSM	Total Miles[1]	SSURGO	GSM
Variations					
Ox Valley East	0	16	16	0	100
Ox Valley East Comparable	0	15	15	0	100
Ox Valley West	<1	16	17	3	97
Ox Valley West Comparable	0	15	15	0	100
Pinto	8	22	29	26	74
Pinto Comparable	8	15	24	36	64

[1] Discrepancies in totals due to rounding.

Table 3.3-14 Summary of Impacts to Soils by Alternatives in Region III

Parameter	Alternative III-A		Alternative III-B		Alternative III-C	
	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)
Water Erosion-Prone	77	24	36	11	62	15
Wind Erosion-Prone	114	30	140	32	105	25
Compaction-Prone	864	232	1,106	269	1,039	250
LRP[1]	1,586	392	1,453	338	1,579	382
Hydric[2]	47	12	33	8	52	13
Prime Farmland	132	31	113	28	286	70
Shallow Bedrock[3]	1,073	331	871	226	759	188
Risk of Corrosion (Concrete)	650	155	669	150	660	154
Risk of Corrosion (Steel)	2,799	740	2,665	644	2,926	708
Shallow Excavation Limitations	1,604	449	1,662	421	1,964	479
Small Commercial Building Limitations	1,486	418	1,568	398	1,906	470
Expansive Soils	141	37	222	56	221	54

[1] Limited Revegetation Potential.

[2] Wet Soils.

[3] Lithic Bedrock 60 inches or less from the soil surface.

Source: NRCS 2011.

Note: GSM data did not have interpretations for hydric soils, shallow excavations, small commercial buildings, or prime farmland. Percentages for these interpretations exclude areas with only GSM data.

Alternative III-A (Applicant Proposed)

Key Parameters Summary

Detailed SSURGO data were analyzed on approximately 71 percent of Alternative III-A. The remaining 29 percent was analyzed using U.S. GSM data. The primary constraints for Alternative III-A during construction would be disturbance of 1,586 acres of soils with limited revegetation potential and 864 acres of compaction prone soils. Mitigation measures **S-1**, **S-2**, **S-3**, **S-5**, **S-9**, **S-13**, and **VG-1** would help to reduce impacts on these soils and increase the potential for revegetation. Soils with limitations associated with the risk of corrosion to steel are prevalent along this route (2,799 acres); however the effects of corrosion on steel structures would be offset by the use of protective coating and cathodic protection. No substantive effect is expected related to corrosion.

Alternative III-B (Agency Preferred)

Key Parameters Summary

Detailed SSURGO data were analyzed on approximately 78 percent of Alternative III-B. The remaining 22 percent was analyzed using U.S. GSM data. The primary constraints for Alternative III-B during construction would be disturbance of 1,453 acres of soils with limited revegetation potential and 1,106 acres of compaction prone soils. Mitigation measures **S-1**, **S-2**, **S-3**, **S-5**, **S-9**, **S-13**, and **VG-1** would help to reduce impacts on these soils and increase the potential for revegetation. Soils with limitations associated with the risk of corrosion to steel are prevalent along this route (2,665 acres); however the effects of corrosion on steel structures would be offset by the use of protective coating and cathodic protection. No substantive effect is expected related to corrosion.

Alternative III-C

Key Parameters Summary

Detailed SSURGO data were analyzed on approximately 84 percent of Alternative III-C. The remaining 16 percent was analyzed using U.S. GSM data. The primary constraints for Alternative III-C during construction would be disturbance of 1,579 acres of soils with limited revegetation potential and 1,039 acres of compaction prone soils. Mitigation measures **S-1**, **S-2**, **S-3**, **S-5**, **S-9**, **S-13**, and **VG-1** would help to reduce impacts on these soils and increase the potential for revegetation. Soils with limitations associated with the risk of corrosion to steel are prevalent along this route (2,926 acres); however the effects of corrosion on steel structures would be offset by the use of protective coating and cathodic protection. No substantive effect is expected related to corrosion.

Alternative Variations in Region III

Table 3.3-16 provides a comparison of impacts associated with the alternative variations in Region III.

Alternative Connectors in Region III

Table 3.3-17 summarizes the characteristics of soils that would be impacted by the various connectors and impacts and advantages associated with the alternative connectors in Region III.

Alternative Ground Electrode System Locations in Region III

Table 3.3-18 summarizes impacts associated with Ground Electrode Systems connectors in Region III.

Table 3.3-15 Project Impacts to Water Erosion-Prone Soils by Watershed in Region III

General Region III		III-A		III-B		III-C		Ox Valley East Alternative Variation		Ox Valley East Alternative Variation - Comparison		Ox Valley West Alternative Variation		Ox Valley West Alternative Variation - Comparison		Pinto Alternative Variation		Pinto Alternative Variation - Comparison		Avon Alternative Connector		Moapa Alternative Connector	
HUC10	Watershed	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)
1501001207	California Wash	24	8	14	4																			1	0
1501001306	Cathedral Gorge-Meadow Valley Wash					45	11																		
1501001305	Clover Creek			2	1	1	0																		
1501001206	Dry Lake Valley	0	0	5	1	20	5																	1	0
1606000909	Dry Lake Valley					1	0																		
1501001204	Elbow Canyon					2	1																		
1603000610	Gold Springs Wash			2	1	2	0																		
1501000512	Government Wash-Colorado River	5	2	5	2	5	1																		
1501001007	Halfway Wash-Virgin River	1	0	1	0																				
1501001307	Kershaw Canyon-Meadow Valley Wash					2	1																		
1603000703	Long Lick Canyon-Big Wash	0	0	0	0	0	0																		
1501001309	Lower Meadow Valley Wash			0	0																				
1501001209	Lower Muddy River	44	13	2	0																				
1501000808	Lower Santa Clara River	7	2																						
1501001203	Middle Pahranagat Wash					0	0																		
1501000806	Moody Wash							1	0			1	0												
1501001504	Nellis Air Force Base					5	1																		

Table 3.3-15 Project Impacts to Water Erosion-Prone Soils by Watershed in Region III

General Region III		III-A		III-B		III-C		Ox Valley East Alternative Variation		Ox Valley East Alternative Variation - Comparison		Ox Valley West Alternative Variation		Ox Valley West Alternative Variation - Comparison		Pinto Alternative Variation		Pinto Alternative Variation - Comparison		Avon Alternative Connector		Moapa Alternative Connector	
HUC10	Watershed	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)
1501001006	Sand Hollow Wash-Virgin River	0	0																				
1603000613	Shoal Creek	6	1					15	6			18	6					6	1				
1603000706	The Big Wash-Beaver River	0	0	0	0	0	0																
1501001005	Toquop Wash	18	7	17	6																		
1501001208	Upper Muddy River	3	1	0	0																		

Note: Blanks denote no impacts.

Source: NRCS 2011; NRCS et al. 2010.

Table 3.3-16 Summary of Region III Alternative Variation Impacts for Soils

Alternative Variation	Analysis
Ox Valley East Alternative Variation	This route would impact more LRP, compaction prone, shallow soils, and soils with severe limitations for risk of corrosion to concrete compared to the comparable Alternative III-A segments.
Ox Valley West Alternative Variation	This route would impact more LRP, compaction prone, shallow soils, and soils with severe limitations for risk of corrosion to concrete compared to the comparable Alternative III-A segments.
Pinto Alternative Variation	This route would impact more LRP, compaction prone, shallow soils, and soils with severe limitations for risk of corrosion to concrete compared to the comparable Alternative III-A segments.

Table 3.3-17 Summary of Region III Alternative Connector Impacts for Soils

Alternative Connector	Analysis	Advantage
Avon Alternative Connector	Approximately 5 acres of wind erodible, 83 acres of LRP, 53 acres of expansive soils, and 60 acres of compaction prone soils would be impacted if this alternative connector were used. No water erodible soils would be impacted.	This connector would result in a reduction of impacts to prime farmland soils associated with the Alternative III-C route and a reduction in overall surface disturbance to soils that would result from Alternative III-C.
Moapa Alternative Connector	Approximately 27 acres of wind erodible, 29 acres of soils with shallow bedrock, 65 acres of LRP, and 8 acres of compaction prone soils would be impacted if this alternative connector were used.	This connector route would result in a small reduction of the acreage of soil resources impacted by Alternative III-C, if used to cross over to Alternatives III-A or III-B.

Table 3.3-18 Summary of Region III Alternative Ground Electrode System Impacts (Acres)[1]

	Wind Erodible	Water Erodible	Compaction Prone	LRP	Hydric	Prime Farmland	Shallow Bedrock	Risk of Corrosion - Concrete	Risk of Corrosion - Steel	Shallow Excavations	Expansive Soils
Halfway Wash- Virgin River (Alternative III-A)	34	30	34	73	0	0	485	73	596	561	34
Halfway Wash- Virgin River (Alternative III-B)	34	30	34	73	0	0	485	73	596	561	34
Halfway Wash East (Alternative III-A)	30	0	0	0	0	0	570	0	600	570	0
Halfway Wash East (Alternative III-B)	30	0	0	0	0	0	570	0	600	570	0
Meadow Valley 2 (Alternative III-C)	14	0	0	0	0	0	269	0	283	269	0
Mormon Mesa- Carp Elgin Rd (Alternative III-A)	29	0	13	13	13	0	558	13	600	571	13
Mormon Mesa- Carp Elgin Rd (Alternative III-B)	29	0	13	13	13	0	558	13	600	571	13
Delta Ground Electrode Bed (DO2)	0	0	198	575	0	0	0	321	575	0	0

[1] Limited Revegetation Potential

[2] Wet Soils

[3] Lithic Bedrock 60 inches or less from the soil surface.

Note: Acreages are based on 600-acre siting areas, but much smaller areas within the siting areas would be required for the facilities as shown in Chapter 2.0, **Table 2-17**.

Region III Conclusion

As presented in **Table 3.3-14**, Alternative III-B would have the greatest impact on compaction prone soils, soils prone to expansion, and wind erodible soils than the other alternatives. Alternative III-A, would impact more acres of LRP soils, soils with shallow bedrock, and soils prone to water erosion. Alternative III-C would impact more acres of hydric soils, prime farmland, soils corrosive to steel, and soils with severe limitations for shallow excavations. While all alternative have their limitations, in general, Alternative III-C would have the highest overall impact on soil resources.

3.3.6.6 Region IV

Region IV would have impacts similar to what is described for the construction impacts discussed in Section 3.3.6.2, Impacts Common to all Alternative Routes and Associated Components.

As stated in Section 3.3.6.4, losses of biological soils crusts would be expected where surface disturbance occurs. Similar impacts to soils would be expected in Region III from loss of surface crusts.

The operation impacts in Region IV would be similar to those discussed in Section 3.3.6.2, Impacts Common to all Alternative Routes and Associated Components. In locations where operations or maintenance activities disturb or remove the protective soil cover (vegetation and vegetative litter) on droughty, saline, or strongly alkaline soils, these soils would highly erodible and difficult to revegetate.

Table 3.3-19 provides a summary of the data sources used for analysis in Region IV. Detailed order 3 SSURGO soil survey data were available for all alternatives within Region IV; therefore, no GSM data were utilized. **Table 3.3-20** provides a comparison of impacts associated with the construction and operation of alternative routes in Region IV. **Table 3.3-21** provides details of water erosion-prone soils impacted by construction and operation by watershed (HUC10; NRCS et al. 2010).

Table 3.3-19 Region IV Data Sources Used for Analysis

	Miles			Percentage	
Alternatives	**SSURGO**	**GSM**	**Total Miles**	**SSURGO**	**GSM**
Alternative IV-A	37	0	37	100	0
Alternative IV-B	39	0	39	100	0
Alternative IV-C	44	0	44	100	0
Connectors					
Sunrise Mountain	3	0	3	100	0
Lake Las Vegas	4	0	4	100	0
Three Kids Mine	5	0	5	100	0
River Mountain	7	0	7	100	0
Railroad Pass	3	0	3	100	0
Variations					
Marketplace	8	0	8	100	0
Marketplace Comparable	7	0	7	100	0

Table 3.3-20 Summary of Impacts to Soils by Alternatives in Region IV

Parameter	Alternative IV-A		Alternative IV-B		Alternative IV-C	
	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)	Const. (acres)	Operat. (acres)
Water Erosion-Prone	16	3	1	0	1	0
Wind Erosion-Prone	1	0	66	20	109	29
Compaction-Prone	0	0	3	1	2	1
LRP[1]	191	48	191	59	166	48
Hydric[2]	0	0	3	1	2	1
Prime Farmland	0	0	0	0	0	0
Shallow Bedrock[3]	153	42	109	41	116	38
Risk of Corrosion (Concrete)	105	23	138	38	124	30
Risk of Corrosion (Steel)	371	97	449	135	519	140
Shallow Excavation Limitations	439	116	465	141	545	144
Small Commercial Building Limitations	439	116	462	140	524	139
Expansive Soils	0	0	3	1	2	1

[1] Limited Revegetation Potential

[2] Wet Soils

[3] Lithic Bedrock 60 inches or less from the soil surface

Source: NRCS 2011

Note: GSM data did not have interpretations for hydric soils, shallow excavations, small commercial buildings, or prime farmland. Percentages for these interpretations exclude areas with only GSM data.

Table 3.3-21 Project Impacts to Water Erosion-Prone Soils by Watershed in Region IV

General Region IV		IV-A		IV-B		IV-C		Marketplace Alternative Variation		Marketplace Alternative Variation - Comparison		Sunrise Mountain Alternative Connector		Lake Las Vegas Alternative Connector		Three Kids Mine Alternative Connector		River Mountain Alternative Connector		Railroad Pass Alternative Connector	
HUC10	**Watershed**	**Const. (acres)**	**Operat. (acres)**	**Const. (acres)**	**Operat. (acres)**	**Const. (acres)**	**Operat. (acres)**	**Const. (acres)**	**Operat. (acres)**	**Const. (acres)**	**Operat. (acres)**	**Const. (acres)**	**Operat. (acres)**	**Const. (acres)**	**Operat. (acres)**	**Const. (acres)**	**Operat. (acres)**	**Const. (acres)**	**Operat. (acres)**	**Const. (acres)**	**Operat. (acres)**
1501001507	Duck Creek-Las Vegas Wash	0	0	0	0	0	0							2	1	1	0				
1606001518	Eldorado Valley					0	0														
1501000512	Government Wash-Colorado River	36	9	21	6	21	6					3	1	1	0	2	1				
1501000513	Gypsum Wash-Colorado River					0	0														
1503010101	Jumbo Wash-Colorado River					1	0														

Note: Blanks denote no impacts.

Source: NRCS 2011; NRCS et al. 2010.

Alternative IV-A (Applicant Proposed and Agency Preferred)

Key Parameters Summary

Detailed SSURGO data were analyzed on 100 percent of Alternative IV-A. The primary soil constraint for Alternative IV-A during construction would be disturbance of 191 acres of soils with limited revegetation potential and 153 acres of soils that have shallow bedrock present. Mitigation measures **S-1**, **S-2**, **S-3**, **S-5**, **S-9**, **S-13**, and **VG-1** would help to reduce impacts on these soils and increase the potential for revegetation. Soils with limitations associated with the risk of corrosion to steel are prevalent along this route (371 acres); however, the effects of corrosion on steel structures would be offset by the use of protective coating and cathodic protection. No substantive effect is expected related to corrosion.

Alternative IV-B

Key Parameters Summary

Detailed SSURGO data were analyzed on 100 percent of Alternative IV-B. The primary soil constraint for Alternative IV-B during construction would be disturbance of 191 acres of soils with limited revegetation potential and 109 acres of soils that have shallow bedrock present. Mitigation measures **S-1**, **S-2**, **S-3**, **S-5**, **S-9**, **S-13**, and **VG-1** would help to reduce impacts on these soils and increase the potential for revegetation. Soils with limitations associated with the risk of corrosion to steel are prevalent along this route (449 acres); however, the effects of corrosion on steel structures would be offset by the use of protective coating and cathodic protection. No substantive effect is expected related to corrosion.

Alternative IV-C

Key Parameters Summary

Detailed SSURGO data were analyzed on 100 percent of Alternative IV-C. The primary constraint for Alternative IV-C during construction would be disturbance of 166 acres of soils with limited revegetation potential and 116 acres of soils that have shallow bedrock present. Mitigation measures **S-1**, **S-2**, **S-3**, **S-5**, **S-9**, **S-13**, and **VG-1** would help to reduce impacts on these soils and increase the potential for revegetation. Soils with limitations associated with the risk of corrosion to steel are prevalent along this route (519 acres); however, the effects of corrosion on steel structures would be offset by the use of protective coating and cathodic protection. No substantive effect is expected related to corrosion.

Alternative Variations in Region IV

Table 3.3-22 provides a summary of impacts associated with the alternative variation in Region IV.

Table 3.3-22 Summary of Region IV Alternative Variation Impacts for Soils

Alternative Variation	Analysis
Marketplace Alternative Variation (Alternative IV-B)	This alternative variation would impact less wind erodible soils and soils with severe limitations for risk of corrosion to concrete than the proposed segments it would replace. This alternative would impact more LRP soils and soils with severe limitations for shallow excavations and small commercial buildings than the comparable Alternative IV-B segments.

Alternative Connectors in Region IV

Table 3.3-23 summarizes the characteristics of soils that would be impacted by the various connectors and impacts and advantages associated with the alternative connectors in Region IV.

Table 3.3-23 Summary of Region IV Alternative Connector Impacts for Soils

Alternative Connector	Analysis	Advantage
Sunrise Mountain Alternative Connector	Approximately 3 acres of water erodible, 20 acres of LRP, and 13 acres of shallow soils would be impacted by this alternative. No compaction prone soils would be impacted by this alternative.	This connector route would result in a reduction of the acreage of LRP and shallow soils impacted by Alternative IV-A, if used to cross over to Alternatives IV-B or IV-C.
Lake Las Vegas Alternative Connector	Approximately 4 acres of wind erodible, 4 acres of water erodible, 18 acres of LRP, and 17 acres of shallow soils would be impacted by this alternative. No compaction prone soils would be impacted by this alternative.	This connector route would result in a reduction of the acreage of soils impacted within the Lake Mead National Recreation Area impacted by Alternatives IV-B or IV-C, if used to cross over to the proposed route.
Three Kids Mine Alternative Connector	Approximately 4 acres of wind erodible, 3 acres of water erodible, 38 acres of LRP, and 46 acres of shallow soils would be impacted by this alternative. No compaction prone soils would be impacted by this alternative.	This connector route would result in a reduction of the acreage of soils impacted within the Lake Mead National Recreation Area impacted by Alternatives IV-B or IV-C, if used to cross over to the proposed route.
River Mountains Alternative Connector	Approximately 12 acres of wind erodible, 39 acres of LRP, and 64 acres of shallow soils would be impacted by this alternative. No compaction prone soils or water erodible soils would be impacted by this alternative.	This connector route would result in a reduction of the acreage of sensitive soils impacted by Alternatives IV-B or IV-C, if used to cross over to the proposed route.
Railroad Pass Alternative Connector (Alternatives IV-A and IV-B)	Approximately 4 acres of LRP and 19 acres of shallow soils would be impacted by this alternative. No compaction prone, wind, or water erodible soils would be impacted by this alternative.	This connector route would reduce the acres of LRP and shallow bedrock soils impacted by Alternative IV-A, if used to cross to the Alternative IV-B route.

Region IV Conclusion

As presented in **Table 3.3-20**, Alternative IV-B and Alternative IV-C would have the greatest impact on soil resources. Alternative IV-B would impact more soils corrosive to concrete, soils prone to shrink-swell, and LRP soils. Alternative IV-C would impact more soils corrosive to steel, and soils with severe limitations for shallow excavations. In general, Alternative IV-A would have the least overall impact on soil resources.

3.3.6.7 Residual Impacts

Mitigation measures are designed to reduce impacts to soil resources but do not fully mitigate the impacts. All of the alternatives would result in site specific losses to long-term soil quality and productivity due to accelerated erosion and soil mixing. Because soil formation of topsoil is a slow process, it can take decades for topsoil to recover in the arid west and for soil productivity to improve.

3.3.6.8 Impacts to Soils from the No Action Alternative

Under the No Action Alternative, the proposed project would not be authorized and would not be developed. Associated impacts to soils from construction and maintenance would not occur. Natural and anthropogenic actions such as erosion, agriculture, fire, recreation, and grazing would continue to impact soil resources at present levels in the analysis area.

3.3.6.9 Irreversible and Irretrievable Commitment of Resources

An irretrievable commitment of a resource is one in which the resource or its use is lost for a period of time. An irreversible commitment of a resource is one in which the resource use is lost permanently or indefinitely. If the transmission line is left in operation on a permanent basis or concrete foundations are left in place during decommissioning an irreversible loss of soil productivity and quality would be lost associated with structure foundations, regeneration sites, substations, terminals, and support facilities. Alternately, an irretrievable commitment of soil resources during the life span of the transmission line would be anticipated until all concrete foundations are removed and successful reclamation is achieved.

3.3.6.10 Relationship Between Local Short-term Uses and Long-term Productivity

Overall site productivity is primarily a matter of revegetation success. Productivity varies with vegetation community, but more importantly, with land management objectives as they relate to the establishment of desirable or productive vegetation types. In contrast, soil quality is an inherent soil resource characteristic involving aeration, permeability, texture, salinity and alkalinity, microbial populations, fertility, and other physical and chemical characteristics that are accepted as beneficial to overall plant growth and establishment. Based on this concept, there would be impacts to short-term uses and long-term productivity related to the quality of native soils after project-related disturbance. However, long-term soil productivity can be restored once successful revegetation is completed.